ABSTRACTS OF NORTH AMERICAN GEOLOGY

May 1967

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1967

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Price 45 cents (single copy). Subscription price: $5.00 a year (12 monthly issues); $1.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (December 8, 1965).

(exp. 12-68)

ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

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8982 **Adams, Jim W.** Memorial to Charles Arthur Janes (1928–1966): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 9, p. 2011–2012, portrait, 1966.

9315 **Agrawal, P. N.** Routine measurements of dynamic strains in engineering structures during earthquakes: Seismol. Soc. America Bull., v. 56, no. 5, p. 1185–1186, 1966.

It is suggested that the most scientific approach to the earthquake problem in designing engineering structures would be to plan routine observations of dynamic strains in critical positions of typical structures in every region during earthquakes, instead of obtaining only ground motions. Earthquakes which shake the structure appreciably but cause little or no damage would also yield useful data.—D.B.V.

9129 **Ahrens, Thomas J.; Duvall, George E.** Stress relaxation behind elastic shock waves in rocks: Jour. Geophys. Research, v. 71, no. 18, p. 4349–4360, illus., tables, 1966.

The elastic shock wave amplitude in Arkansas novaculite decreases at a rate of about 3.3 kb per mm for shock propagation paths 6 to 12 mm long. A total variation of elastic shock wave amplitude (Hugoniot elastic limit) of about 40 kb (from 110 to 70 kb) is observed in about 1 cm of shock travel. The intrinsic attenuation term in a constitutive equation for a stress-relaxing elastoplastic material accounts for about 90 percent of the observed peak pressure attenuation of the elastic shock, as compared with the about 10 percent predicted from the instantaneous elastic shock profile. The Hugoniot elastic limits of Sioux and Eureka quartzites also decrease with shock propagation path length.—D.B.V.

9289 **Alabama Geological Society; Copeland, Charles W.** (editor). Facies changes in the Alabama Tertiary—Guidebook for the fourth annual field trip, Dec. 1966: University, Ala., Alabama Geol. Soc., 103 p., illus., 1966.

Facies changes in the Alabama Tertiary range in age from Paleocene to Oligocene. Some of the more striking changes take place within the Clayton, Porters Creek, and Tallahatta Formations and the Red Bluff Clay, all observable in the southwestern part of the state covered by this field trip. Eight research synopses are cited separately.—G.D.C.

9336 **Alexander, W. H., Jr.; White, D. E.** Ground-water resources of Atascosa and Frio Counties, Texas: Texas Water Devel. Board Rept. 32, 203 p., illus., tables, 1966.

Ground water, essential to the economy of Atascosa and Frio Counties, meets 99.8 percent of irrigation and other needs. Large quantities of fresh water are obtained from wells supplied from the Carrizo Sand, the principal aquifer; four other aquifers, Queen City Sand, Edwards and associated limestone, Wilcox Group, and Sparta Sand yield smaller quantities. The Carrizo has been the principal source for more than 60 years; large withdrawals during the past 14 years have caused significant declines in water levels of these wells; future development is more dependent on cost of pumping water than on its availability. During 1961–64 pumpage was about four times the recharge rate, and most water was taken from storage.—*from* Authors' abstract

9344 **Allen, William B.; Hahn, Glenn W.; Brackley, Richard A.** Availability of ground water, upper Pawcatuck River basin, Rhode Island: U.S. Geol. Survey Water-Supply Paper 1821, 66 p., illus., tables, 1966.

Two ground-water reservoirs composed of glacial deposits of sand and gravel in the upper Pawcatuck River basin are capable of yielding 17- and 8.6 mgd, respectively. The smaller reservoir, in the Chipuxet River valley, contains water that is higher in dissolved solid and iron content. Only about 1.5 mgd of water is used in the basin, most of it for public supplies and from wells not tapping the Usequepaug-Queen or Chipuxet reservoirs. Estimates of the 25 mgd of ground water potentially available are believed to be conservative, and substantially larger quantities may actually be available when development takes place.—W.L.G.

9445 **Allison, Ira S.** Fossil Lake, Oregon—Its geology and fossil faunas: Oregon State Mon. Studies Geology, no. 9, 48 p., illus., tables, 1966.

Fossil Lake is a small playa in the Fort Rock-Christmas Lake basin, a downfaulted depression in the High Lava Plains of south-central Oregon occupied in the Pleistocene by Fort Rock Lake. At Fossil Lake, deflation by wind has removed all surficial material and locally part of the Pleistocene lake beds. Intercalated volcanic ash beds are correlated in sections of the main excavation sites. Fossil birds (68 species), fishes, and snails occur in the beds a few feet above the major disconformity; radiocarbon age of snail shells is 29,000 years (late Wisconsin). Mammal bones (23 species), found directly above the major disconformity, may be 40,000 years old or more if the disconformity represents a mid-Wisconsin interstade; if, less likely, it represents the Sangamon interglacial stage, they could be 70,000 years old.—V.M.J.

Ammentorp, Willis F. *See* Frenzel, Hugh N. 9188

Andersen, Neil. *See* Angino, Ernest E. 9305

9235 **Anderson, Christian Donald.** Telluric current surveys in Utah [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1183B, 1966.

9326 **Anderson, Don L.; Niazi, M.; Julian, B.** Upper mantle structure from new body wave travel time, apparent velocity and attenuation data [abs.], *in* Internat. Symposium Geophys. Theory and Computers, 2d, Rehovoth, Israel, 1965, Proc.: Royal Astron. Soc. Geophys. Jour., v. 11, nos. 1-2, p. 253-254, 1966.

9039 **Anderson, Duwayne M.; Reynolds, Robert C.** Umiat bentonite—An unusual montmorillonite from Umiat, Alaska: Am. Mineralogist, v. 51, nos. 9-10, p. 1443-1456, illus., tables, 1966.

Two bentonite beds, ten to twelve inches thick, consist of nearly pure montmorillonite, with some beidellitic characteristics. The d-spacing of 060 indicates a dioctahedral clay. The exchange complex is sodium saturated. The bentonite re-expanded after lithium solvation, heating, and glycolating, but Wyoming bentonite did not re-expand. Both have like infrared curves.—M.L.L.

Anderson, Roger Y. *See* Dean, Walter E., Jr. 9184

Andrews, Henry N. *See* Schopf, James M. 9427

9305 **Angino, Ernest E.; Billings, Gale K.; Andersen, Neil.** Observed variations in the strontium concentration of sea water: Chem. Geology, v. 1, no. 2, p. 145-153, illus., tables, 1966.

On samples obtained from five widely separated areas of the North Atlantic Ocean, 91 determinations of strontium were made. These include surface and deep-water samples from both the cold North Atlantic area and the warm subtropical Caribbean area. The results differ from many of the previously reported values for strontium in sea water. It appears that the more correct value for *soluble* strontium in sea water is less than the commonly accepted figure of 8.0-8.2 mg/l and most likely lies between 7.2 and 7.8 mg/l. The use of an "average" figure for strontium in

sea water should be discouraged as it is clear that the soluble strontium content *does* vary considerably; consequently the assumption of a "constant" strontium/chlorinity ratio in the ocean is in error.—Authors' summary

8939 **Anonymous.** The Moulton Pool, Toole County, Montana, and Alberta, Canada, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 186–190, illus., 1966.

The Moulton oil pool is located on the northwest flank of the Kevin–Sunburst dome, and the Montana portion is within the boundaries of the Cut Bank field. Cretaceous stratigraphy is reviewed briefly, the Moulton lenticular sand lying about 160 feet above the Jurassic. Cumulative production is over one million bbls, and the area is still being actively developed.—E.S.L.

Appuhn, Richard A. *See* Goodman, Richard E. 9085

9377 **Archbold, Norbert L.** Recent exploration for metallic deposits in Nevada [abs.]: Mining Eng., v. 18, no. 12, p. 46, 1966.

Armstrong, Frank C. *See* Oriel, Steven S. 8902

9354 **Arriens, P. A.; Brooks, C.; Bofinger, V. M.; Compston, W.** The discordance of mineral ages in granitic rocks resulting from the redistribution of rubidium and strontium: Jour. Geophys. Research, v. 71, no. 20, p. 4981–4994, illus., tables, 1966.

Examples of discordant Rb–Sr mineral ages in granitic rocks from Australia illustrate a pattern of postcrystallization isotopic redistribution not previously recorded. Biotite retains the age of crystallization measured from total-rock samples, but K-feldspar gives a younger age and plagioclase an older age if the calculations are made using the total-rock initial Sr-87/Sr-86 ratio. Neither isotopic homogenization nor redistribution of Rb is considered probable under conditions which failed to affect the Rb–Sr and K–Ar ages of biotite in these rocks, and a mechanism of expulsion of radiogenic Sr-87 from the K-feldspar is favored. The internal redistribution of Rb and Sr can be specified by four models of isotopic movement; the pattern of response in any rock would depend on the intensity of the postcrystallization event.—Authors' abstract

9382 **Ash, Richard L.; Casquino, Walter T.** Conical stress waves generated by explosive charges—Their observation and significance in blasting [abs.]: Mining Eng., v. 18, no. 12, p. 48, 1966.

8995 **Babcock, Larry L.** The manganese-bearing minerals of Champion mine, Champion, Michigan [abs.]: Am. Mineralogist, v. 51, nos. 9–10, p. 1560–1561, 1966.

9139 **Back, William; Cherry, Rodney N.; Hanshaw, Bruce B.** Chemical equilibrium between the water and minerals of a carbonate aquifer, *in* Limestone hydrology—A symposium with discussion: Natl. Speleol. Soc. Bull., v. 28, no. 3, p. 119–126, illus., 1966.

The major artesian aquifer in central Florida, Tertiary limestone, is being studied. Field measurements of pH, temperature, and bicarbonate concentration are used with analyses of water samples to calculate an ion-activity product for calcite, aragonite, and dolomite. The major recharge area is characterized by calcium bicarbonate type water, low concentrations of dissolved solids, and undersaturation with respect to calcite and dolomite. Solution of dolomite and limestone can occur several hundred feet below the water table in the recharge area. Concentration of total dissolved solids increases with length of flow path and duration of residence. Throughout most of the area, water has not reached equilibrium with aragonite. Study of mineral equilibrium and isotopic composition of the water provides an understanding of its geologic history from which the rate of solution in a system may be determined.—*from* Authors' abstract

9161 **Bailey, E. H.** Mercury, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 106–109, illus., 1966.

The total production of mercury in Washington has been less than 7,000 flasks, nearly all of which has come from the Morton district in Lewis County. In this district two adjacent properties, the Roy and Barnum–McDonnell mines, yielded about 6,500 flasks between 1926–35 but since 1940 have been largely inactive. The rocks of the district are shale, tuffaceous sandstone, and Eocene coal, all intruded by basic sills and dikes. Some rich ore consists of cinnabar in coal, which is unusual. The known deposits in Washington lack large, rich ore bodies, but their ores can be mined profitably when the price of mercury is sufficiently high. The wide distribution of mercury in the State, however, suggests that further search for deposits should be undertaken.—W.L.G.

Baillie, J. *See* Pye, E. G. 9435

8932 **Baird, P. D.** Frank Debenham (1884–1965): Arctic, v. 19, no. 2, p. 210–211, 1966.

9413 **Baker, Arthur, 3d.** Mining districts and regional structure in the southwestern Basin and Range [abs.]: Mining Eng., v. 19, no. 1, p. 63, 1967.

8926 **Ballard, W. W.** Petrography of Jurassic and Cretaceous sandstones, north flank of Little Belt Mountains, Montana, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 56–70, illus., tables, 1966.

To help solve the Jurassic–Cretaceous boundary problem, sandstones were examined in areas where their age is indisputable to determine if significant differences exist. A total of 170 samples, representing the Swift, Morrison, and basal Kootenai, was collected from three surface sections, and thin sections were made from four well cores in Toole and Liberty Counties. Field and petrographic characteristics are given, and the mineralogy including heavy mineral studies tabulated and diagrammed. Only those categories which are completely absent in one or the other set of samples are marked as significant to use as distinguishing characteristics. Not enough subsurface sections have been studied to warrant firm conclusions, but results to date correlate with the Little Belt surface study and suggest that correlation and boundary problems might be greatly aided by petrographic studies.—E.S.L.

Balthaser, Lawrence H. *See* Howard, James F. 9008

9080 **Barker, Daniel S.** Application of plastic peel techniques to the study of silicate rocks: Am. Mineralogist, v. 51, nos. 9–10, p. 1541–1544, illus., 1966.

Use of the plastic peel technique is advocated for the study of stained and unstained igneous and metamorphic rocks. Peels are especially useful for low-cost modal analysis of coarse, variable or porphyritic rocks.—B.C.H.

Barr, W. *See* Müller, F. 8930

9037 **Barrett, Peter J.** Effects of the 1964 Alaskan earthquake on some shallow-water sediments in Prince William Sound, southeast Alaska: Jour. Sed. Petrology, v. 36, no. 4, p. 992–1006, illus., 1966.

A study of four subtidal and intertidal areas in Prince William Sound was made following the 1964 Alaskan earthquake to determine its effect on the unconsolidated sediment. Principal results of the quake were (1) a limited mass movement of sediment causing local warping and rupture and (2) changes in grain-size distribution caused by uplift. Effects definitely attributable to large waves associated with the quake could not be recognized.—E.D.M.

Basler, J. A. *See* Dinwiddie, G. A. 9458

Bayley, Richard W. *See* Roberts, Ralph J. 9378

Bayrock, L. A. *See* Trylich, C. 9016

9464 **Beales, F. W.; Jackson, S. A.** Precipitation of lead-zinc ores in carbonate reservoirs as illustrated by Pine Point ore field, Canada: Inst. Mining and Metallurgy Trans., Sec. B, v. 75, Bull. 720, p. B278-B285, illus., 1966.

The Pine Point Mississippi Valley type orebodies in the Northwest Territories are used as a case history to illustrate the proposed theory of sulfide precipitation where compaction-generated basinal fluids meet sulfide-carrying formation waters in carbonate reservoirs. Major orebodies can be expected where a porosity-permeability trend acted as a channel. The Pine Point orebodies occur in Presqu'ile dolostone in the Middle Devonian, a dolomitized reefoid trend. Associated evaporites furnished the hydrogen sulfide.—E.S.L.

9394 **Beall, John V.** Phosphate rock in the United States, *in* Phosphate and potash—Minerals to feed the world: Mining Eng., v. 18, no. 10, p. 80-99, illus., table, 1966.

The forecast of continued growing demand for phosphate, chiefly for fertilizer, has sparked much exploration for phosphate rock. The phosphate-producing areas of current economic importance are: Florida (alluvial pebble deposits); North Carolina (interbedded phosphatic clays, limestones, and sands); Tennessee (brown rock deposits); western, in portions of Montana, Idaho, Wyoming and Utah (Permian Phosphoria Formation). The exploration, mining, and milling operations of the active companies in each of these areas are briefly summarized. Because phosphate rock is a high bulk, low value commodity, the eastern districts are in a more favorable economic position due to their proximity to the big fertilizer-producing areas.—F.C.C.

Beamer, N. H. *See* Rasmussen, W. C. 8977

9000 **Bebout, D. G.** Upper Pennsylvanian Conemaugh corals from Ohio: Kansas Univ. Paleont. Contr.—Paper 6, 7 p., illus., 1966.

Corals occur in three marine limestones—Lower Brush Creek, Upper Brush Creek, and Ames Limestones—in the Upper Pennsylvanian Conemaugh of Athens County, Ohio. Four new species of corals belonging to the lophophyllidid genus *Stereostylus* and one unnamed form [possibly assignable to *Lophophyllidium*] are characterized on the basis of a study of more than 400 specimens.—Author's abstract

9138 **Bedinger, M. S.** Electric-analog study of cave formation, *in* Limestone hydrology—A symposium with discussion: Natl. Speleol. Soc. Bull., v. 28, no. 3, p. 127-132, illus., 1966.

An electric analog, conforming to the conditions on which the study of limestone solution leading to cavern development is based, has been constructed and used to define the pattern and density of ground-water flow. Successive models illustrate progressive solution and changes in flow. Results of the analog study support the following conclusions: (1) solution channels generally decrease in size with depth and with lateral distance from the point of ground-water discharge, (2) the larger solution channels are above or near the elevation of the point of discharge and have greater lateral than vertical extent. This second observation supports the theory that the major zone of cave formation is at shallow depth beneath the water table.—*from* Author's abstract

9279 **Beikman, H. M.; Gower, H. D.** Coal, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 272-286, illus., table, 1966.

The principal coal deposits of Washington are subbituminous and bituminous coals, with some small deposits of lignite and anthracite, and occur in relatively small areas separated by older non-coal-bearing rocks or by a cover of younger rocks. Principal deposits are along the western margin of the Cascade Range in a

discontinuous belt that extends from the Canadian border south to the Columbia River. Knowledge of the coal deposits is confined to individual coal-bearing areas and little is known about the intervening areas or the relation of one to another. Therefore, in this report, descriptions of coal deposits are given by county and by separate geographic areas within the counties.—W.L.G.

Béland, René. *See* Hashimoto, Tsutomu. 9463

9466 **Bell, David L.** A comparative study of glauconite and the associated clay fraction in modern marine sediments: Florida State Univ. Sedimentol. Research Lab. Contr. 16, 112 p., illus., tables, 1966.

Crystallinity and mineralogy of the glauconite and clay fractions of 65 samples from six contemporary marine environments were investigated by X-ray diffraction. In areas of authigenic glauconite, a correlation is demonstrated between mineralogy and degree of crystallinity of glauconite pellets and of the clay fraction. Detrital and relic glauconites exhibit different mineralogies as compared to the associated clay fractions. No consistent relationship is observed between degree of crystallinity and pellet color. Glauconite on the southern Atlantic shelf of the United States is concluded to be authigenic and that from Santa Monica Bay to be detrital. [Other glauconites studied were from the shelf sediments off Guinea, the Scotia Ridge (Antarctica), the Morocco continental shelf, and the Chatham Rise in the Pacific.].—*from* Author's abstract

9096 **Bemmelen, R. W. Van.** The evolution of mega-undations—A mechanical model for large-scale geodynamic phenomena. *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-14, p. 373-399, illus. table [1966].

Mega-undations, the largest deformations of the Earth's crust, result from deep-seated mass circuits. The arching is partly compensated by gravity spreading of the upper layers. Where mega-undations occur in continental regions, new oceanic basins are opened, mid-oceanic ridges form at the crest, and relatively deep parts of the outer mantle rise to the ocean floor. The displaced continental shield has distinctive geotectonic features, frontal geosynclinal subsidence (followed by orogenesis), extension phenomena at its rear, and right- and left-lateral faults on its starboard and port sides respectively. These features are illustrated by the Atlantic mega-undation and the associated drift of North America, and by the geotectonic evolution of the Indian Ocean.–*from* Author's abstract

9329 **Bennett, Gerald.** Strachan township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P.347, scale 1 in. to 1/2 mi., text, 1966.

Oldest rocks in Strachan township are Precambrian basic, intermediate, and acidic volcanics. A narrow band of arkosic quartzite is conformable with foliation and lineation of amphibolite in the central part of the township. Volcanic rocks have been intruded by gabbro with associated serpentinite and diorite. The eastern half of the area is underlain by an inhomogeneous mass of acidic intrusive rocks, most classed as hybrid granite. A northwesterly-trending swarm of Matachewan quartz diabase dikes cuts all the rocks. Small drag folds were observed in the amphibolite but no major fold structures could be delineated. Minor amounts of disseminated pyrite occur in less metamorphosed basic volcanic rocks; disseminated magnetite and ilmenite are found throughout the mafic intrusive rocks.—M.C.M.

9271 **Bennett, W. A. G.; Weis, P. L.; Weissenborn, A. E.** Magnesite, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 224-231, illus., table, 1966.

Most of the magnesite mined in Washington is used to make dead-burned magnesite, principally for refractory brick. Fifteen occurrences of magnesite are described in this report which have been found in the belt of outcrops of the Stensgar Dolomite in Stevens County.—W.L.G.

9274 **Bennett, W. A. G.** Salines, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 245–250, illus., table, 1966.

The tonnage of salts in the more important saline lakes in the State of Washington is given in a table, and the locations of these lakes are shown on a map.—W.L.G.

9447 **Berkner, Lloyd V.; Marshall, Lauriston C.** Oxygen and evolution: New Scientist, v. 28, no. 469, p. 415–419, illus., 1966.

Free oxygen in the primitive atmosphere must have formed by break-up of water molecules by ultraviolet light or by photosyntheses. Life, synthesized at the water surface by ultraviolet rays, could live only with 30 to 40 feet of water as a shield. With energy-supply through respiration, complex organisms developed, and when oxygen levels reached one percent of the present, could exist at shallow levels and spread, as at the beginning of the Cambrian. When the levels reached 10 percent, life could evolve ashore, as in the late Silurian explosion. By Carboniferous, oxygen content may have exceeded the present, and loss of infrared-absorbing CO_2 produced Permian ice ages. Resulting reduction in photosynthesis would cause a catastrophic drop in oxygen content. The theory may also explain subsequent catastrophes, such as that which overtook the great reptiles.—E.S.L.

Bernard, H. A. *See* Ginsburg, R. N. 9038

9307 **Bicker, Alvin R., Jr.** Claiborne County geology, *in* Claiborne County geology and mineral resources: Mississippi Geol. Econ. and Topog. Survey Bull. 107, p. 9–94, illus., tables, geol. map, 1966.

The Miocene Catahoula Formation is the only Tertiary unit exposed in Claiborne County, Miss., which lies within the Gulf Coastal Plain. It is overlain locally by pre-loess terrace materials, loess, and alluvium. Three piercement-type salt domes are present in the subsurface, one of which is producing natural gas. Clays and sand and gravel are of possible economic importance, and salt from the Bruinsberg dome is the most promising subsurface prospect. A cross section, table of water-well records, and core descriptions of 69 test wells are included.—E.S.L.

8973 **Bikerman, Michael; Damon, Paul E.** K/Ar chronology of the Tucson Mountains, Pima County, Arizona: Geol. Soc. America Bull., v. 77, no. 11, p. 1225–1234, illus., table, 1966.

K-Ar age determinations on rocks in the Tucson Mountains indicate two main periods of volcanic activity. The Cat Mountain Rhyolite, Biotite Rhyolite, and Shorts Ranch Andesite, which comprise and older group, range in age from 57 m.y. to 70 m.y. and are Late Cretaceous to early Tertiary (Laramide). K-Ar ages of 71 m.y. to 75 m.y. for the intrusive rocks near Amole Peak are close to that of the Cat Mountain Rhyolite. Rocks in the younger group range in age from 20 m.y. to 30 m.y. and are late Oligocene to Miocene. Similar isotopic ages of the mid-Tertiary rocks near Safford Peak and the Tumamoc Hill-"A" Mountain area suggest a closer relationship between these two sequences than previously thought.—D.H.W.

Billings, Gale K. *See* Angino, Ernest E. 9305

8929 **Billings Geological Society; Cox, James E.** (editor). Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., 227 p. illus., table, geol. map, 1966.

This volume, dedicated to Charles E. Erdmann, contains five stratigraphic, two economic, and five oil field papers, all of which are cited separately, and two papers on drilling on the Sweetgrass arch. A stratigraphic chart, four cross sections, six road logs, and a six-paper bibliography are included.—E.S.L.

9446 **Birot, Pierre; Dresch, Jean.** Pédiments et glacis dans l'Ouest des États-Unis: Annales Géographie, v. 75, no. 411, p. 513–552, illus., 1966.

French authors, unlike American, usually distinguish between "pediment" proper (an erosion surface cut in a rock that is mechanically hard, commonly crystalline in the fresh state) and "glacis" (a surface cut in rocks mechanically soft in the fresh state). Three genetic types of glacis can be distinguished: erosion or ablation glacis, covered glacis, glacis of pure accumulation. Pediments and glacises are examined, and their processes interpreted, in four regions of western U.S.: Rocky Mountain foothills in the Denver, Colo., region; interior basins of the Northern Rocky Mountains; border of monoclinal escarpments in tabular structures of the Colorado Plateau; and basins and ranges of New Mexico and Arizona, the extension of the Mexican Highland. Possibilities of correlating the erosion systems with different climatic phases of the Quaternary are discussed.—V.M.J.

8916 **Black, Robert F.** Comments on periglacial terminology: Biul. Peryglacjalny, no. 15, p. 329–333, 1966.

The writer reviews a meeting held to discuss the problem of terminology in mass wasting deposits. Brief answers are given to 11 questions presented on periglacial areas, their limits, relationship to glaciers and to permafrost, climatic features, possible divisions, and preferred use of similar terms. The definition of permafrost, as now used, is satisfactory, and a dual classification of ice in the ground, geometric and genetic, is urged.—E.S.L.

Blais, R. *See* Machairas, G. 9049

9128 **Block, Barry; Moore, R. D.** Measurements in the earth mode frequency range by an electrostatic sensing and feedback gravimeter: Jour. Geophys. Research, v. 71, no. 18, p. 4361–4375, illus., 1966.

A gravimeter designed to use an electrostatic null-seeking servo is described. The position sensor is a capacitor plate system. A phase-sensitive detection system is used, and feedback forces are applied to the mass via the same capacitor plate system. The design of the system is such that all aspects of its behavior, including the effects of all internal noise sources, can be calculated and measured. With this instrument noise was studied in the frequency range 1 to 30 cph. The results are described along with an analysis of instrumental noise sources and measurements of their power spectrums.—D.B.V.

Blusson, S. L. *See* Roots, E. F. 9327

8904 **Bodkin, Hillard W.; Hagan, Wallace W.** James Harold Poteet (1896–1965): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2622, portrait, 1966.

Bofinger, V. M. *See* Arriens, P. A. 9354

Bogard, D. D. *See* Rowe, M. W. 9356

Bogard, D. D. *See* Rowe, M. W. 9425

Bohidar, Naikananda K. *See* Wilson, John E. 9381

9069 **Borg, Iris; Handin, John.** Experimental deformation of crystalline rocks: Tectonophysics, v. 3, no. 4 (spec. issue), p. 249–368, illus., tables, 1966.

Eighteen typical igneous or metamorphic "basement" rocks have been experimentally deformed at about one percent per min under "shallow" conditions (1 kbar, 150°C) and, together with two important rock-forming minerals—biotite and plagioclase—under "deep" conditions (5 kbar, 500°C). Under shallow conditions, rocks are essentially brittle and fail after a few percent shortening on shear fractures or faults inclined at 21–33° to the maximum principal compressive stress. In short-time tests, predominant mode of deformation even under deep conditions is still faulting except in favorably oriented micaceous rocks. The fault angles lie between 27° and 38° in the nonfoliated rocks. Gneiss and slate are appreciably weaker when load is applied at 45° to planar anisotropy. Petrofabric studies revealed certain deformation mechanisms that may serve as clues to principal stress directions in naturally deformed rocks.—*from* Authors' abstract

9031 **Borst, Roger L.** A mineralogical study of some Lower Devonian (Helderberg) rocks of the central Hudson Valley, New York: Jour. Sed. Petrology, v. 36, no. 3, p. 775–793, illus., 1966.

X-ray analysis of about 150 samples of Lower Devonian rocks from central New York State indicate that mudstone and carbonate rocks were deposited in essentially the same environments. The shift from mudstone deposition to carbonate deposition was controlled at the depositional site by a factor that could not be identified. Spectrographic analyses of six samples each of mudstone and carbonate rock indicate similar minor element compositions for the two rock types.—H.A.T.

Bostick, F. X., Jr. *See* Patrick, F. W. 9132

9004 **Bostock, H. H.** Feldspar and quartz phenocrysts in the Shingle Creek porphyry, British Columbia [with French, German and Russian abs.]: Canada Geol. Survey Bull. 126, 70 p., illus., tables, geol. map, 1966.

The Tertiary Shingle Creek porphyry, exposed in an area of about seven sq mi near Penticton, intrudes a basement complex, chiefly granodiorite, and is bordered on the south by tuff and agglomerate of the Springbrook Formation, which may be remnants of a volcanic cone connected with the porphyry. These rocks are partly overlain by the basic volcanic rocks of the Marron Formation. Optical and X-ray diffraction methods, and chemical and modal analyses were used to study the porphyry which is coarsely porphyritic with sanidine, plagioclase, and quartz phenocrysts, and is differentiated into albite-bearing and oligoclase-bearing phases. The optical, textural, and chemical features of the large phenocrysts are described, especially sanidine, and their crystallization discussed. Several structural features suggest that the porphyry reached the early Tertiary surface.—E.S.L.

9005 **Bostock, H. H.** Geology, Shingle Creek porphyry, British Columbia: Canada Geol. Survey Map 1169A (also in Bull. 126), scale 1:9,600, section, 1965 [1966].

9222 **Boström, Kurt.** The origin of some elements of economic interest in deep-sea sediments [abs.]: Mining Eng., v. 19, no. 1, p. 62, 1967.

9175 **Boucot, Arthur J.; Yochelson, Ellis L.** Paleozoic Gastropoda from the Moose River synclinorium, northern Maine: U.S. Geol. Survey Prof. Paper 503-A, p. A1–A20, illus., table, 1966.

Large-scale collecting in the Moose River synclinorium, mainly of Devonian age beds, has yielded only scattered gastropods. The bulk of specimens are *Platyceras*, but 25 species are recognized in Ordovician–Devonian strata. Most material is poorly preserved, and open nomenclature is employed. One new genus is named; the new bellerophontacean family Plectonotidae is also named. Occurrences of a *Nidulites* and an ophiuroid are noted.—A.J.B.

Boucot, Arthur J. *See* Schopf, James M. 9427

9297 **Boutcher, S. M. A.; Edhorn, A.-S.; Moorhouse, W. W.** Archaean conglomerates and lithic sandstones of Lake Timiskaming, Ontario [with French summ.]: Geol. Assoc. Canada Proc., v. 17, p. 21–42, illus., tables, 1966.

These sediments, well exposed along the western short of Lake Timiskaming with minor argillites and siltstones, are moderately well sorted, the larger sand grains subangular to subrounded. The sandstones are highly crossbedded and all types of sediments are disturbed by slump and contemporaneous faulting and folding. They are composed largely of detritus derived from nearby andesitic, dacitic, and rhyolitic volcanics which accumulated to a thickness of at least several thousand feet. An unusual feature is local abundance of clastic hornblende and pyroxene. Metamorphism is low grade, predominantly greenschist facies; formations dip steeply. Well-rounded plutonic boulders are thought to have come from subvolcanic intrusions; clastic quartz and feldspar weathered out of porphyries, plutonic rocks, and crystal tuffs.—G.D.C.

9217 **Boyle, R. W.** Geochemical prospecting research in 1966, Cobalt area, Ontario: Canada Geol. Survey Paper 66-46, 15 p., illus., tables, 1966.

From a survey of prospecting results in the Cobalt area during 1966, it is concluded that: (1) analyses of clay and derived soils are not effective for silver prospecting in the Cobalt area; (2) analyses of till and derived soils should be effective, with A horizon giving the best response, and Ag, As, Sb, and Mn the best indicator elements; (3) both drill core samples and rock chips indicate the presence of veins; (4) radiometric surveys proved negative; and (5) great care must be taken in this area because of contamination. The average elemental composition of rocks, soils, till, and clay is tabulated.—E.S.L.

9322 **Boyle, R. W.; Jambor, J. L.** Mineralogy, geochemistry, and origin of the Magnet Cove barite-sulphide deposit, Walton, N. S.: Canadian Mining and Metall. Bull., v. 59, no. 654, p. 1209-1228, 1966.

The Magnet Cove barite-sulphide deposit is a ranking pipe-like body that replaced and partly filled a large brecciated zone at the junction of the two faults at the contact between sedimentary rocks of the Horton and Windsor Groups of Mississippian age. The principal minerals in the deposit are siderite, barite, hematite, pyrite, marcasite, galena, sphalerite, chalcopyrite, tennantite, proustite, pearceite, acanthite, stomeyerite and gersdorffite. The mineral assemblage and textural relationships indicate that the minerals were deposited from low-temperature solutions. The source of the elements in the deposit is believed to be enclosing sedimentary rocks, with connate or ground waters as the transporting medium, and solubility products as the governing factor controlling the abundance and order of deposition of the minerals.—Authors' abstract

9311 **Brace, W. F.; Orange, A. S.** Electrical resistivity changes in saturated rock under stress: Science, v. 153, no. 3743, p. 1525-1526, illus., 1966.

Electrical resistivity of water-saturated crystalline rock such as granite, diabase, dunite, or quartzite changes by an order of magnitude prior to fracture of the rock in compression. The effect observed even under high confining pressure is due to formation of open cracks which first appear at one-third to two-thirds the fracture stress.—Authors' abstract

Brackley, Richard A. *See* Allen, William B. 9344

9182 **Bradbury, J. P.** Pleistocene-Recent geologic history of Zuni Salt Lake, New Mexico [abs.], *in* Guidebook of Taos-Raton-Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 119, 1966.

Brady, Sharon. *See* O'Donoghue, Catherine. 9393

9442 **Branson, Carl C.** Geologic background of petroleum and natural gas in Oklahoma: Interstate Oil Compact Comm. Comm. Bull., v. 8, no. 1, p. 1-5, illus., 1966.

Oklahoma's oil and gas comes almost entirely from Paleozoic rocks at depths from about 1,000 to 17,000 feet, in 70 of the 77 counties; a few small Mesozoic fields are in the Gulf Coastal Plain. Bed-rock exposures include Cambrian igneous in the Wichita Mts., Tertiary non-marine cover in the northwest, and Pleistocene basalt in the far corner of the panhandle. Thickness of sedimentary sequence varies from zero to over 40,000 feet; deep basins are west-central, southern, and locally southwestern; thin shelf-type sediments or deeply eroded uplifts are in the several mountainous areas. Sketch maps indicate the distribution of rocks by age, thickness of sedimentary sequence, major structural features of oil-bearing rocks, and production age. Multiple pay sections are notable.—G.D.C.

9428 **Breslau, David.** On an earthquake and aftershock mechanism relating to a model of the crust and mantle [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 3, p. 836B-837B, 1966.

9474 **Brice, James C.** Erosion and deposition in the loess-mantled Great Plains Medicine Creek drainage basin, Nebraska: U.S. Geol. Survey Prof. Paper 352-H, p. 255-335, illus., tables, 1966.

An integrated account is given of geologic and hydrologic factors pertinent to erosion and deposition in the Medicine Creek basin, a typical part of the loess-mantled Great Plains but with a somewhat higher relief, degree of dissection, and rate of erosion than average. Major factors in gullying, channel deposition, and discharge of water and sediment through channels are evaluated. Climatic changes and land-use factors are evaluated as causes of erosion, and processes of scarp erosion are analyzed, gullies classified, and areal distribution of gullies correlated with morphology. Hydraulic geometry of channels is expressed by slope of curves relating width, depth, and velocity to discharge.—V.S.N.

9029 **Briggs, John C.** Zoogeography and evolution: Evolution, v. 20, no. 3, p. 282-289, 1966.

"Two contrasting kinds of evolutionary change are taking place simultaneously. Successful evolution, which occurs in the major centers of dispersal, develops slowly and is likely to produce dominant species that can become widespread and have a potential phyletic future. Unsuccessful evolution, typical of areas peripheral to the major centers, takes place rapidly and produces species that are limited in their ability to penetrate other areas and in their phyletic future."—V.M.J.

9420 **Briggs, Louis I.** Computer modeling of evaporite deposition [abs.]: Mining Eng., v. 18, no. 12, p. 45, 1966.

Brooks, C. *See* Arriens, P. A. 9354

9213 **Brooks, David B.** Deep sea manganese—Resource or phenomenon [abs.]: Mining Eng., v. 19, no. 1, p. 62, 1967.

9423 **Brown, Douglas R.** Geology—A critical factor in urban development [abs.]: Mining Eng., v. 18, no. 12, p. 45, 1966.

9053 **Brown, J. W.; Singh, M. M.** An investigation of microseismic activity in rock under tension: Soc. Mining Engineers Trans., v. 238 [!235], no. 3, p. 255-265, illus., 1966.

Bedford limestone, Crab Orchard sandstone and Chelmsford granite were chosen for the study to determine the effects of static fatigue, loading rate, repeated loading, and rock anisotropy compared to compression and bending loads. The microseismic method may be a potential tool in location in situ of dangerously stressed strata, as well as predicting rock failures. Noises emitted under load, or the rate of energy, are computed for varying conditions. The tests were conducted at constant load on a dead weight loading machine at various load levels. Results reported include the relation of total energy emitted to tensile strength of rock, and the possibility of simulating a phenomenological model for microseismic activity. Plots of some of the experiments are included.—E.S.L.

9025 **Brown, Jerry.** Soils of the Okpilak River region, Alaska: U.S. Army Materiel Command, Cold Regions Research and Eng. Lab. Research Rept. 188, 49 p., illus., tables, 1966.

The glacial geology of Okpilak Valley is reviewed, and effects of frost action in the soils of the region are considered under the surficial configuration (patterned ground) and the internal morphological characteristics. About 55 types of soil conditions and surface features are described and illustrated. Soils of the solifluction slopes possess no orderly profile, although all contain buried organic matter. In the glaciated and periglacial areas, sorted features predominate on the coarse textured substrata. Arctic brown soils are distributed on well-drained sites, and acid parent material is more important than time and environment in depth and development of arctic brown solum on valley moraine sequences. Weakening of soil-forming processes with increasing altitude is suggested. A combination of peaty soils associated with ice-wedge polygons constitutes an organic terrain.—E.S.L.

9036 **Brown, Philip R.** Pyritization in some molluscan shells: Jour. Sed. Petrology, v. 36, no. 4, p. 1149–1152, illus., 1966.

Decomposition of organic matter within shell fragments appears to result in the formation of localized reducing environments. This has led to the development of pyrite within the shell. This pyrite may indicate relic shell structure and thus show that the aragonite of the shell changed to calcite without a distinct solution-cavity stage. In other cases, pyrite distribution shows the more probable mode of alteration to have been solution of aragonite followed almost immediately by precipitation of calcite.—Author's abstract

9341 **Brown, Richmond F.** Hydrology of the cavernous limestones of the Mammoth Cave area, Kentucky: U.S. Geol. Survey Water-Supply Paper 1837, 64 p., illus., tables, 1966.

Ground water [in Mammoth Cave National Park] occurs as perched and semiperched bodies in sandstone, shale, and limestone and under water-table conditions at the level of the Green River in thick soluble limestone. Recorders indicate that precipitation on Mammoth Cave plateau recharges underlying sandstone rapidly. Ground water from the sandstone discharges horizontally to plateau edges and vertically to underlying formations. Some precipitation recharges formations immediately through overland flow to sinkholes and through open shafts to pools at the water table. Much precipitation on Pennyroyal plain flows overland into sinkholes and then through solution openings to Green River. Water from Green River flows into solution channels under Mammoth Cave plateau and discharges again to the River downstream. Salt water in the River makes it possible to trace water movement underground.—*from* Author's abstract

8980 **Brown, S. G.; Davidson, E. S.; Kister, L. R.; Thomsen, B. W.** Water resources of Fort Huachuca Military Reservation, southeastern Arizona: U.S. Geol. Survey Water-Supply Paper 1819-D, p. D1–D57, illus., tables, 1966.

Main sources of water available in the Fort Huachuca Military Reservation area are ground water stored in two unconsolidated sedimentary deposits filling the San Pedro basin, and spring flow in Garden and Huachuca Canyons in the Huachuca Mountains. The upper and lower units of the aquifer yield the major part of the fort's water supply and pumping has caused the water level in the well field to decline three feet per year. In Garden Canyon, spring flow is derived from solution channels and fractures in carbonate rocks, and in Huachuca Canyon from fractures in mudstone, sandstone, carbonate rocks, and granite. Spring flow, if used to supplement the ground-water supply, will decrease the draft on the ground-water reservoir in the two basin-fill units; or it could be used for artificial recharge to these aquifers.—*from* Authors' abstract

Brune, James N. *See* Liebermann, Robert C. 9131

9324 **Bryant, Bruce.** Possible window in the Elk Range thrust sheet near Aspen, Colorado, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D1–D8, illus., table, 1966.

Structurally complex rocks underlie structurally simple rocks of Permian and Pennsylvanian age in the Conundrum Creek valley. Both the overthrust sheet and the underlying rocks, as well as the boundary between them, have been intruded by Tertiary granodiorite and subjected to hornblende hornfels facies metamorphism. Seven miles to the southwest a section of Maroon Formation 10,000 feet thick has been carried over a section of Maroon Formation only 1,000 feet thick along the Elk Range fault. The Conundrum Creek area may be a window in the Elk Range thrust sheet, which was derived by the sliding off the Sawatch Range uplift of a thick section of rock from the interior of the central Colorado trough.—Author's abstract

Bryant, Donald G. *See* Gustafson, William G. 9095

Buffington, Edwin C. *See* Scholl, David W. 9007

9014 **Burger, H. Robert, 3d.** Structural framework of Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 1–8, illus., 1966.

Regional structures of Paleozoic sedimentary rocks in Indiana reflect the influence of the Cincinnati arch which extends through the state from southeast to northwest, and the Michigan and Illinois basins to the northeast and southwest. Large depressions, highs, and scarps in the Precambrian crystalline basement are expressed by these three big structures and by the LaSalle anticline, the Rough Creek fault system, and the Mt. Carmel fault, most of which underwent prolonged development. The Kentland dome is considered a cryptovolcanic structure.—G.D.C.

Burke, Kevin. *See* Goreau, T. 9203

Busch, C. D. *See* Matlock, W. G. 9477

9077 **Buseck, Peter R.; Keil, Klaus.** Meteoritic rutile: Am. Mineralogist, v. 51, nos. 9–10, p. 1506–1515, illus., tables, 1966.

Rutile has not been widely recognized as a meteoritic constituent. Recent microscopic and electron microprobe studies show, however, that TiO_2 is a reasonably widespread phase, albeit in minor amounts. X-ray diffraction studies confirm the TiO_2 to be rutile. It was observed in the following meteorites: Allegan, Bondoc, Estherville, Farmington, and Vaca Muerta. The rutile is associated primarily with ilmenite and chromite, in some cases as exsolution lamellae.—Authors' abstract

9047 **Butler, J. Robert; Siple, George E.** Geology and mineral resources of York County, South Carolina: South Carolina Div. Geology Bull. 33, 65 p., illus., tables, geol. map, 1966.

Rocks of York County are mostly within the Charlotte Belt of intrusive igneous and high-rank metamorphic rocks. Igneous rocks range from adamellite to gabbro. Phyllites of the Carolina Slate Belt and high rank metamorphics of the Kings Mountain Belt are also present. Major mineral products have been gold and kyanite. Ground water reservoir includes water from pore space of the weathered residuum and from fractures and openings in bedrock.—M.S.T.

8934 **Caldwell, D. W.** Pleistocene geology of Mt. Katahdin, Trip C, *in* Guidebook for field trips in the Mount Katahdin region, Maine—New England Intercollegiate Geol. Conf., 58th Ann. Mtg. 1966: [Augusta, Maine, Maine Geol. Survey] p. 51–57, illus., 1966.

Post-continental and late continental glaciation on Mt. Katahdin are recorded by several well-preserved cirques with prominent end moraines and a lateral moraine of the last continental glacier to be active in this area. Mt. Katahdin reflects the differences in resistance to erosion of its granite and the surrounding sedimentary rocks. Erratics near the summits of mountains in the region support the theory of continental glaciation. It is possible that Mt. Washington in New Hampshire was the center of a large ice cap when valley glaciers were active on Mt. Katahdin. Their erosion surfaces have been correlated.—G.D.C.

9310 **Caley, Earle R.; Easby, Dudley T., Jr.** Indium as an impurity in ancient western Mexican tin and bronze artifacts and in local tin ore: Science, v. 155, no. 3763, p. 686–687, 1967.

The presence of indium in a nodule of cassiterite from the State of Guerrero increases the probability that ancient tin and bronze artifacts from Guerrero, which contain indium as an impurity, were made locally from metal extracted from local tin ore.—Authors' abstract

9410 **California Dept. Water Resources.** Hydrologic data, 1964—V. 1, North coastal area: California Dept. Water Resources Bull. 130-64, v. 1, 100 p., illus., tables, 1966.

The Bulletin 130 series of reports presents basic hydrologic data for California previously published annually in Bulletins 23, 39, 65, 66, and 77, which it replaces. It will be published yearly in five volumes, each covering a specific area of the State. Volume 1 covers Del Norte, Humboldt, and parts of adjoining counties. Tabular data for fiscal year 1963–64 are presented in Appendixes A through E: climate, surface water flow, ground-water measurements, surface water quality, ground-water quality.—V.M.J.

8996 **Cameron, E. M.** A geochemical method of correlation for the Lower Cretaceous strata of Alberta [with French, German and Russian abs.]: Canada Geol. Survey Bull. 137, 30 p., illus., tables, 1966.

Lower Cretaceous strata in southwestern and central Alberta were sampled at close vertical intervals in nine outcrop and subsurface sections. Na_2O and K_2O were determined by flame photometry; values corrected to a carbonate-free basis show that the rocks may be divided into three stratigraphic divisions, each of distinctive soda content, which may be traced throughout the area. The mean carbonate-corrected Na_2O content of the lower division is 0.21 percent; middle, 2.37 percent; and upper, 0.87 percent. Potash is found to be less useful for correlation, but Na_2O+K_2O shows the distribution of clean sandstones, which may contain oil and gas. The geographic distribution of alkalis is discussed, and the chemical boundaries compared to existing paleontologic and lithologic correlations. Trends in alkali content may be helpful in detecting stratigraphic traps.—*from* Author's abstract

9368 **Cameron, E. M.** Evaluation of sampling and analytical methods for the regional geochemical study of a subsurface carbonate formation: Jour. Sed. Petrology, v. 36, no. 3, p. 755–763, 1966.

When studying regional geochemical variation of elements from drill cuttings, sampling error is at a minimum for elements that occur in the principal mineral component of the rocks. Data on strontium and magnesium in the Slave Point Formation, which consists of carbonate rocks, are more reliable indicators of facies changes than aluminum, silicon, iron, and titanium that occur chiefly in admixed detrital minerals. Elements in secondary minerals such as barite or sphalerite are not reliable indicators.—H.A.T.

Cameron, E. N. *See* Ramsden, A. R. 9081

9452 **Canada Dept. Energy,Mines,Resources; Canada Geological Survey.** Principal mineral areas of Canada: Canada Geol. Survey Map 900A, 16th edition, scale 1:7,603,200, 1966.

The map sheet contains an index to principal producing areas to January 1966 with names of operating companies; mineral production by minerals, value, and provinces; an index to principal oil and gas fields as of January 1966; and inset maps showing producing and potential areas for various minerals.—M.C.M.

8942 **Canada Geological Survey.** Aeromagnetic map, Canyon City, Yukon Territory: Canada Geol. Survey Geophysics Paper 4260, scale 1:63,360, 1966.

8943 **Canada Geological Survey.** Aeromagnetic map, Dry Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4261, scale 1:63,360, 1966.

8944 **Canada Geological Survey.** Aeromagnetic map, Niggerhead Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4262, scale 1:63,360, 1966.

8945 **Canada Geological Survey.** Aeromagnetic map, Scottie Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4263, scale 1:63,360, 1966.

8946 **Canada Geological Survey.** Aeromagnetic map, Wienerwurst Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 4264, scale 1:63,360, 1966.

8947 **Canada Geological Survey.** Aeromagnetic map, Sheet 115 N/2, Yukon Territory: Canada Geol. Survey Geophysics Paper 4265, scale 1:63,360, 1966.

8948 **Canada Geological Survey.** Aeromagnetic map, Rice Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4266, scale 1:63,360, 1966.

8949 **Canada Geological Survey.** Aeromagnetic map, Borden Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4267, scale 1:63,360, 1966.

8950 **Canada Geological Survey.** Aeromagnetic map, Crag Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 4268, scale 1:63,360, 1966.

8951 **Canada Geological Survey.** Aeromagnetic map, Sixtymile, Yukon Territory: Canada Geol. Survey Geophysics Paper 4269, scale 1:63,360, 1966.

8952 **Canada Geological Survey.** Aeromagnetic map, Forty Mile, Yukon Territory: Canada Geol. Survey Geophysics Paper 4270, scale 1:63,360, 1966.

8953 **Canada Geological Survey.** Aeromagnetic map, Mount Gladman, Yukon Territory: Canada Geol. Survey Geophysics Paper 4271, scale 1:63,360, 1966.

8954 **Canada Geological Survey.** Aeromagnetic map, Last Chance Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4272, scale 1:63,360, 1966.

8955 **Canada Geological Survey.** Aeromagnetic map, Tepee Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 4273, scale 1:63,360, 1966.

8956 **Canada Geological Survey.** Aeromagnetic map, Koidern, Yukon Territory: Canada Geol. Survey Geophysics Paper 4274, scale 1:63,360, 1966.

8957 **Canada Geological Survey.** Aeromagnetic map, Sanpete Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4275, scale 1:63,360, 1966.

8958 **Canada Geological Survey.** Aeromagnetic map, Snag, Yukon Territory: Canada Geol. Survey Geophysics Paper 4276, scale 1:63,360, 1966.

8959 **Canada Geological Survey.** Aeromagnetic map, Caledonia Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4277, scale 1:63,360, 1966.

8960 **Canada Geological Survey.** Aeromagnetic map, Katrina Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4278, scale 1:63,360, 1966.

8961 **Canada Geological Survey.** Aeromagnetic map, Ladue Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4279, scale 1:63,360, 1966.

8962 **Canada Geological Survey.** Aeromagnetic map, Sheet 115 N/8, Yukon Territory: Canada Geol. Survey Geophysics Paper 4280, scale 1:63,360, 1966.

8963 **Canada Geological Survey.** Aeromagnetic map, Matson Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4281, scale 1:63,360, 1966.

8964 **Canada Geological Survey.** Aeromagnetic map, Enchantment Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4282, scale 1:63,360, 1966.

8965 **Canada Geological Survey.** Aeromagnetic map, California Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4283, scale 1:63,360, 1966.

8966 **Canada Geological Survey.** Aeromagnetic map, Cassiar Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4284, scale 1:63,360, 1966.

8967 **Canada Geological Survey.** Aeromagnetic map, Shell Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4285, scale 1:63,360, 1966.

8968 **Canada Geological Survey.** Aeromagnetic map, Sheet 116 C/16, Yukon Territory: Canada Geol. Survey Geophysics Paper 4286, scale 1:63,360, 1966.

Canada Geological Survey. *See* Canada Dept. Energy,Mines,Resources. 9452

8925 **Cannon, James L.** Outcrop examination and interpretation of paleocurrent patterns of the Blackleaf formation near Great Falls, Montana, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 71–111, illus., 1966.

The Blackleaf Formation has four members: Flood, Taft Hill glauconitic, Vaughn bentonitic, and Bootlegger. All but the Vaughn are marine, with dark gray to black shales alternating with sandstones; they were probably deposited as bars, barrier islands, or shoreline sands, with rapid marine transgressions accounting for the shales. The lower sandstones have a southwest paleocurrent direction, while the remainder have a southeast pattern. During early Vaughn time streams, meandering east to west, deposited a heterogeneous mixture of alluvial sands and shales in a widespread clastic wedge thinning eastward. Later Vaughn sediments were deposited in a swamp and terminate in lignitic shale. Outcrop data are recorded in graphic form on data sheets and the composite sections correlated with well logs. Eight maps show sand distribution and paleocurrent pattern.—E.S.L.

9234 **Cargo, David Niels.** Polygonal strain systems in the Cordilleran foreland, western United States [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1183B, 1966.

9431 **Carmichael, Ian S. E.** The iron–titanium oxides of salic volcanic rocks and their associated ferromagnesian silicates: Contr. Mineralogy and Petrology, v. 14, no. 1, p. 36–64, illus., tables, 1967.

Analytical data, used to estimate quenching temperature and oxygen fugacity on ferromagnesian minerals crystallizing early in salic volcanics, indicate liquidus temperatures, at unknown total pressure, of acid volcanics to be commonly around 900°C. Temperature and oxygen-fugacity data derived from the coexisting oxides show that at any given temperature, the fugacity of oxygen is higher in the presence of an orthopyroxene phenocryst than of an iron-rich olivine. This interdependence of composition and species is surprising as ferromagnesian phases are often present in extremely small amounts. The composition of biotites taken in conjunction with the oxide data suggests that Lassen dacites started to precipitate biotite at a depth of 1 km, these being the only rocks where the oxide data may be relevant to the biotite phenocrysts.—G.D.C.

Carrison, L. C. *See* Sclar, C. B. 9436

9285 **Carter, William D.; Gualtieri, James L.** Geology and uranium–vanadium deposits of the La Sal quadrangle, San Juan County, Utah, and Montrose County, Colorado: U.S. Geol. Survey Prof. Paper 508, 82 p., illus., tables, geol. maps, 1965 [1966].

Exploration of the La Sal quadrangle, about 240 sq mi of San Juan County, Utah, and Montrose County, Colo., has resulted in discovery of 115,000 tons of uranium–vanadium ore in a mineral-rich belt trending N. 70° E., approximately 6 mi long, and from 500 to 3,000 feet in width. Strata of the ore-bearing sandstone range in thickness from a few feet to 105 feet. The stratigraphy, igneous petrology, structural geology, and ore deposits are described and exploration guides which were successfully used in the La Sal Creek area are indicated.—V.S.N.

Casquino, Walter T. *See* Ash, Richard L. 9382

Cater, F. W. *See* Weissenborn, A. E. 9150

9133 **Chakraborty, K. L.** Ferromagnesian silicate minerals in the metamorphosed iron-formation of Wabush Lake and adjacent areas, Newfoundland and Quebec [with French, German, and Russian abs.]: Canada Geol. Survey Bull. 143, 34 p., illus., tables, 1966.

The Wabush iron-formation, a metamorphosed Precambrian ferruginous sediment in the southern Labrador syncline, is divided into three main lithologic units (oxide, silicate, and carbonate). A large number of ferromagnesian and lime silicate minerals have been formed by metamorphic reactions; their chemical and optical properties

and modes of occurrence have been studied, and identifications confirmed by X-ray studies. Members of the cummingtonite-grunerite series are the most abundant silicates, occurring in all three phases. The anthophyllite-cummingtonite—manganoan-cummingtonite relationship is discussed and shown on graphs. The study has contributed new evidence on paragenesis of silicate minerals, suggesting that the iron-formation was metamorphosed isochemically with a minimum possible migration of material.—E.S.L.

9233 **Chambers, Arthur Edwin.** Geology and mineral deposits of part of the Bayhorse Mining District, Custer County, Idaho [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1183B–1184B, 1966.

9115 **Champlin, Jerry B. F.; Thomas, Rex D.** Separation by ultrasonic elutriation and analysis of the fine particles in sandstone: Jour. Sed. Petrology, v. 36, no. 4, p. 1152–1156, illus., 1966.

The combination of an ultrasonic cleaner with filtration and elutriation apparatus removes fine (less than 50 micron diameter) particles from crushed sandstone with more efficiency than routine wet sieving. An electronic particle counter used in conjunction with the separation apparatus permits determination of the size distribution of the particles removed.—R.A.C.

9459 **Chandler, Marjorie E. J.** Fruiting organs from the Morrison Formation of Utah, U.S.A.: British Mus. (Nat. History) Bull., Geology, v. 12, no. 4, p. 138–172, illus., 1966.

New apparently gymnospermous fruiting organs are described from the Brushy Basin Member of the Morrison Formation (very late Jurassic) near Willow Springs, Emery County, Utah. They are preserved as internal crystalline casts of external molds; the surficial features of the plant are preserved, but little of the internal structure. Except for *Sequoia* sp., they differ from all Mesozoic plants previously known. *Behuninia joannei* n. gen. n. sp., megasporophyll with seeds, is classed as a cycad. *Jensenispermum redmondi* n. gen. n. sp., seeds with embryo, endosperm, integument, etc., preserved, may be a cycadophyte. *Hillistrobus axelrodi* n. gen. n. sp. is a conifer (Taxodineae?). What appear to be cupules enclosing seeds are referred to the form-genus *Carpolithus*; these include the new species *C. provoensis and C. radiatus*. V.M.J.

Cheney, T. M. *See* Roberts, Ralph J. 9045

Cherry, Rodney N. *See* Back, William. 9139

9383 **Chlumecky, Nicholas.** Investigation of bearing strength of strata [abs.]: Mining Eng., v. 18, no. 12, p. 48, 1966.

9288 **Chopra, Anil K.** The importance of the vertical component of earthquake motions: Seismol. Soc. America Bull., v. 56, no. 5, p. 116–1175, illus., 1966.

Response spectra and spectrum intensity for the vertical component of strong motions recorded at El Centro (1940), Olympia (1949) and Taft (1952) are evaluated. Comparison with results for horizontal ground motion components indicates: (1) spectrum intensity of vertical components is about 20 to 30 percent of that for horizontal components, and (2) spectra for vertical components are relatively accentuated in the shorter-period and reduced in the longer-period range. Results of analysis of a typical earth dam cross-section subjected separately to two (N. 69° W. and vertical) components of Taft ground motion are presented. The significance of response to vertical ground motion is discussed. It is concluded that effects of vertical component of ground motion are large enough to warrant consideration for this class of structures.—*from* Author's abstract

Chramiec, Mark A. *See* Krause, Dale C. 9059

8927 **Christopher, J. E.** Shaunavon (Middle Jurassic) sedimentation and vertical tectonics in southwestern Saskatchewan, *in* Symposium, Jurassic and Cretaceous

stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 18–35, illus., 1966.

The oil reservoirs of the Shaunavon, combined with those of the Jurassic Vanguard and Cretaceous Blairmore, constitute the second largest oil producing district in the province. The upper Shaunavon is composed of three lithologic units, the middle one of which is divided into four subunits. Maps and fence diagrams show these facies. Shaunavon sedimentation was influenced by draping over the Madison limestone and Precambrian terrains. An isopach map of the pre-upper Shaunavon is included. The strong rectangular morphology emerged from long-term negative vertical movements, probably reflecting adjustment of Precambrian joint blocks. The location of oil fields at the down-dip edge of the permeable facies may reflect down-dip flow of formation water as well as control by lineaments acting on primary porosity.—E.S.L.

Church, W. R. *See* Young, G. M. 9471

9348 **Clark, A. Horell.** Mackinawiitin termisistä ominaisuuksista—A discussion [of paper by O. Vaasjoki, 1966]: Geologi, v. 18, no. 7, p. 97–98, 1966.

On the basis of annealing studies (Clark, 1966) on mackinawite from Ylöjärvi, Finland (low in Ni and Co), Mackinaw and Muskox mackinawites of North America, and others, it is suggested that the upper stability limit of the mineral is dependent on Ni and Co contents, being reached at higher temperatures with increasing solid solution of these elements, rather than depending directly on the Fe:S ratio as considered by Takeno (1965). Although synthesis of tetragonal iron sulfide under dry conditions was unsuccessful (Clark, 1966), in the binary Fe-S system, tetragonal $Fe_{1+x}S$—corresponding to mackinawite—probably occupies a narrow or vertical field in the approximate composition range $Fe_{1.04-1.07}S$ below about 135°C. The Hitura mackinawite (Vaasjoki, 1966), being associated with pentlandite, probably contains considerable Ni.—V.M.J.

9232 **Clark, Joseph Clyde.** Tertiary stratigraphy of the Felton–Santa Cruz area, Santa Cruz Mountains, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1184B, 1966.

9371 **Clark, K. F.** Structural control on intrusion, alteration and ore deposition in the Red River district, New Mexico [abs.]: Mining Eng., v. 18, no. 12, p. 52, 1966.

9092 **Clark, Kenneth F.** Geology of the Sangre de Cristo Mountains and adjacent areas, between Taos and Raton, New Mexico, *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 56–65, illus., 1966.

The Sangre de Cristo Mts. are a north-trending chain between the Rio Grande depression and the Raton basin, and can be subdivided into the Taos Range on the west, and Cimarron Range on the east, separated by the Moreno Valley. Formations range from Devonian(?) to Tertiary. In the Red River area, a Miocene volcanic series rests on Precambrian crystallines. Acid intrusives have been emplaced in several areas, and some are of economic importance. The Taos horst, which is truncated by the Red River graben, and the anticlinal core of the Cimarron Range, are dominant structures. The synclinal structure of the Moreno Valley, possible diapiric structure of the Cimarron Range, and structural evolution of the area are discussed.—E.S.L.

Clark, R. S. *See* Kuroda, P. K. 9429

9301 **Clarke, Garry K. C.** Seismic survey, northwest Greenland, 1964: U.S. Army Materiel Command, Cold Regions Research and Eng. Lab. Research Rept. 191, 19 p., illus., tables, 1966.

The thickness of the Greenland icecap has been determined by seismic sounding along the trail from Camp TUTO to Camp Century, and on traverses northwest and southwest from Camp Century. The average velocity of vertically traveling

waves was estimated using the first-arrival data from reflection records and the 10-m temperature at each location. Results of three long refraction profiles and measurements of temperature, density, and seismic velocities at the Camp Century drill hole were used to check velocity estimates. An empirical formula from Robin (1958) satisfactorily related seismic wave velocities to the temperature and density of the firn and ice. A two-layer glacier model having a homogeneous ice layer overlain by a firn layer in which the P-wave velocity increased linearly with depth was used. [Data including ice thickness and bedrock dip and elevation are tabulated].—Author's abstract

9396 **Cloud, Preston E., Jr.; Nelson, C. A.** Phanerozoic-cryptozoic and related transitions—New evidence: Science, v. 154, no. 3750, p. 766–770, illus., 1966.

The fossil *Pteridinium*, a distinctive component of a worldwide early metazoan (Ediacaran) assemblage, is provisionally recorded from probable Early Cambrian strata in eastern California. In context with other evidence, this finding implies a Cambrian age for the Ediacaran fauna and approximate coincidence of limits between Phanerozoic-Cryptozoic, Paleozoic-Precambrian, and Cambrian-Precambrian.—Authors' abstract

9397 **Cloud, Preston E., Jr.** Beach cusps—Response to Plateau's rule?: Science, v. 154, no. 3751, p. 890–891, illus., 1966.

It is suggested that beach cusps form in response to the nearly regular segmentation of the cylindrical wave form against the beach, as predicted from Plateau's rule, but with local complications due to hydrodynamic variations and beach regimen. If this is true, the average spacing of beach cusps would reflect the height of the waves that produced or is producing them—a relation that, if it could be expressed more precisely, would contribute to the synoptic study of coastal conditions.—D.B.V.

9409 **Clowers, Stanley R.** Pleistocene Mollusca of the Box Marsh deposit, Admaston Township, Renfrew County, Ontario, Canada: Sterkiana, no. 22, p. 31–59, illus., tables, 1966.

Twenty-two species of mollusks (6 sphaerid pelecypods and 4 ctenobranchiate, 10 aquatic pulmonate, and 2 terrestrial gastropods) are described, and their paleoecology is interpreted from a quantitative study of vertical distribution of the lacustrine fauna in 27 two-inch-thick samples from a stratigraphic section of the Box Marsh marl deposit. The deposit post-dates retreat of the last ice sheet and inundation by the Champlain sea; marl could have started accumulating 9500 years ago or earlier and continued until extinction of the lake, probably before the end of the cold climate period prior to beginning of the Hypsithermal, about 8000 years ago. The faunal succession shows progressively changing conditions and migration patterns that probably reflect late Wisconsin adjustments in the previously displaced climatic zones.—V.M.J.

8908 **Coates, D. F.** Discussion of "Application of the finite element method of analysis in solving boundary value problems in rock mechanics," by W. Blake [1966]: Internat. Jour. Rock Mechanics and Mining Sci., v. 3, no. 4, p. 351, 1966.

It was stated in Blake's paper (ibid., no. 3, p. 169–180, 1966) that up to 1,000 elements can be handled, depending on programming efficiency, on a computer with a 32K storage. Coates states that since the stiffness matrix in this case would be of the order of $1{,}000 \times 1{,}000$, it would be of great value if Blake could provide some information, either with a flow chart or some statements in FORTRAN, on the elimination of the unnecessary zero elements.—E.S.L.

9237 **Collett, L. S.; Sawatzky, P.** The Serson direct-reading proton free-precession magnetometer—Pt. 1, Shipborne use: Canada Geol. Survey Paper 65-31, p. 1–32, illus., tables, 1966.

The value of the magnetic field is displayed directly in gammas. A digital-to-analog converter is designed to be used with a pen recorder, although a digital printer or punch-tape recorder can directly program a digital counter. Sensitivity of ± 0.1

gamma is attainable with an accuracy of ±0.5 gamma with a magnetic field range from 43,000 to 67,500 gammas. Since 1960 over 50,000 line miles have been surveyed using this instrument on board ship.—Authors' abstract

Compston, W. *See* Arriens, P. A. 9354

9107 **Cook, Kenneth L.** Rift system in the Basin and Range province, *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–14, p. 246–279, illus. [1966].

Recent geophysical evidence defining the rift system in the eastern Basin and Range province shows that it is not a continuous rift valley, but en echelon belts of grabens. The Wasatch trench is such a belt in north-central Utah. Seismic and gravity surveys indicate it is about 160 mi long and 13 mi wide, bounded by at least two major faults on the west and three on the east. Gravity surveys have defined a major graben west of the Hurricane fault and the Pilot-Grouse Creek rift belt in northwestern Utah. Gravity and seismic profiles across the Basin and Range Colorado Plateau boundary indicate that the former coincides with the landward extension of the East Pacific Rise and has an abnormally thin crustal layer underlain by a layer of mantle-crust mix. A change in direction of the convection current might account for the invasion of right-lateral movement in this area.—E.S.L.

9414 **Coolbaugh, Melville J.** Special problems of mining in deep potash [abs.]: Mining Eng., v. 18, no. 12, p. 44, 1966.

9476 **Cooper, G. Arthur; Grant, Richard E.** Permian rock units in the Glass Mountains, west Texas: U.S. Geol. Survey Bull. 1244-E, p. E1–E9, illus., 1966.

Rock units in the Leonard Series and the lower part of the Guadalupe Series are subdivided and named in order to provide a detailed framework for forthcoming studies of paleontology, biostratigraphy, and correlation. Limestone members in the Hess, Skinner Ranch, and Cathedral Mountain Formations of the Leonard Series and in the Word Formation of the Guadalupe Series are named and correlated locally. The Road Canyon is elevated to the rank of formation and transferred from the Guadalupe Series to the Leonard Series.—Authors' abstract

Cooper, James B. *See* Dinwiddie, George A. 9093

Copeland, Charles W. *See* Alabama Geological Society. 9289

9298 **Copeland, M. J.** Some leperditiid Ostracoda from the Richardson Mountains, northern Yukon Territory [with French summ.]: Geol. Assoc. Canada Proc., v. 17, p. 43–51, illus., 1966.

Study of Ordovician and Silurian faunas from Yukon Territory has revealed numerous well-preserved ostracods. Of these, specimens of the Leperditicopida are the most distinctive element. Those described here from stratigraphic sections in the Illtyd Range and White Mountains were previously determined by the author and recorded by Norford (1964). These two limestone sections are separated by several thousand feet of graptolitic-bearing rocks of the Road River Formation in a 200 mile interval. Suggested correlation is extremely tenuous.—G.D.C.

9030 **Cotter, Edward.** Limestone diagenesis and dolomitization in Mississippian carbonate banks in Montana: Jour. Sed. Petrology, v. 36, no. 3, p. 764–774, illus., 1966.

Mississippian carbonate banks in central Montana were diagenetically altered in three major stages. Most of the diagenesis occurred during subaerial exposure of the tops of the banks soon after accumulation. The banks were rigid by reason of submarine precipitation of crusts of aragonite before emergence. Fracturing and dissolution accompanied emergence. Lithification of lime mud and recrystallization of aragonite accompanied circulation of non-marine water in the banks. Interstitial water and evaporation produced hypersaline craters that contributed to formation of dolostone. Minor diagenetic effects were produced by pre-emergence formation of chert and post-emergence dedolomitization.—G.O.B.

Cox, James E. *See* Billings Geological Society. 8929

9090 **Craddock, Campbell.** Memorial to Charles Leonard Bieber (1901–1965): Geol. Soc. America Bull., v. 77, no. 11, p. P205–P209, portrait, 1966.

9073 **Craig, Gordon Younger; Oertel, Gerhard.** Deterministic models of living and fossil populations: Geol. Soc. London Quart. Jour., v. 122, pt. 3, p. 315–354, illus., tables, 1966.

Factors influencing size-frequency distribution of living and dead populations of organisms include kind of recruitment (even, broad wave, sharp wave, and two waves of recruitment during the year); growth-rate (linear, high-to-low as in many invertebrates, and high-to-zero as in vertebrates); different coefficients of variation in growth-rate; mortality rate; and seasonal cessation of growth, with or without increased mortality. Forty-two steady-state experiments using different combinations and permutations of these variables were run in a computer and results expressed as size-frequency graphs of populations for use as an aid to interpretation of size-frequency in living and dead fossil populations. Growth-rate and mortality rate are the major factors influencing primary shape of size-frequency distribution.—*from* Authors' abstract

9209 **Crawford, María Luisa Busé.** Plagioclase feldspar equilibria in some semi-pelitic schists [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1184B–1185B, 1966.

9218 **Creath, Wilgus B.** New isochilinid ostracode from the West Spring Creek Formation (Arbuckle Group) of Oklahoma: Oklahoma Geology Notes, v. 26, no. 10, p. 243–246, illus., 1966.

Two species of *Isochilina* of similar morphology occur on opposite sides of the Ordovician Arbuckle-Simpson lithologic boundary in southern Oklahoma. The Arbuckle species, *Isochilina kamara*, is new; the Simpson species, *Eoleperditia? obesiporosa* Harris, has been reexamined and is assigned to the genus *Isochilina*. Both species are described and illustrated.—E.S.L.

9170 **Cridland, Arthur A.** An apparatus for hydrofluoric acid macerations: Micropaleontology, v. 12, no. 4, p. 510, illus., 1966.

An efficient apparatus for hydrofluoric acid macerations, consisting of a Teflon beaker, a magnetic hot-plate stirrer, and a reflux condenser, is described and figured. At least 3 ml. of acid should be used per gram of rock to be digested, a volume suggested after considering the reactions of the main rock components based on data for shale and sandstone. This apparatus not only combines rapid processing with a low consumption of acid, but, once set up, needs no more than casual attention.—G.D.C.

Crittenden, M. D., Jr. *See* Roberts, Ralph J. 9045

9353 **Csallany, Sandor.** Yields of wells in Pennsylvanian and Mississippian rocks in Illinois: Illinois Water Survey Rept. Inv. 55, 43 p., illus., tables, 1966.

In areas of the southern three-fourths of Illinois where glacial drift is thin or practically impermeable, water supplies are obtained from wells in thick rocks of Pennsylvanian and Mississippian age. Commonly yielding less than 25 gpm, these wells are the only available supply of water for several thousand farms and homes and several hundred small municipalities and industries; average depths in Pennsylvanian and Mississippian rocks are 170 and 250 feet, respectively. From 1920–63 about 250 well-production tests were made on more than 200 wells penetrating these rocks, and statistical analysis of specific-capacity data provided a basis for comparing the productivity of individual formations. Probable ranges of yields of wells in undeveloped areas can be estimated from the specific-capacity frequency graphs and information on availability of ground water from these rocks in 88 counties.—*from* Author's abstract

9388 **Culbertson, William C.** Trona in the Green River basin of Wyoming [abs.]: Mining Eng., v. 18, no. 12, p. 52, 1966.

Cummings, T. Ray. *See* Whitcomb, Harold A. 8978

9183 **Cunningham, John E.** A Cretaceous vertebrate from the Big Burro Mountains, Grant County, New Mexico [abs.], *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 119, 1966.

9340 **Curry, Robert R.** Glaciation about 3,000,000 years ago in the Sierra Nevada: Science, v. 154, no. 3750, p. 770–771, illus., table, 1966.

Major glaciation in the Sierra Nevada of California resulted in the deposition of till which underlies latite dated by the K–Ar method as 2.7 m.y. old and overlies andesite dated as 3.1 m.y. old. This till, here called the Deadman Pass till, is the oldest Pleistocene glacial deposit yet recognized in temperate latitudes.—D.B.V.

Daigle, E. E. *See* Ginsburg, R. N. 9038

9061 **Dailey, Donald H.; Popenoe, W. P.** Mollusca from the Upper Cretaceous Jalama Formation, Santa Barbara County, California: California Univ. Pubs. Geol. Sci., v. 65, 27 p., illus., tables, 1966.

The Jalama Formation consists of about 2,300 feet of sandstone and shale here grouped into seven members. The molluscan fauna consists of 53 taxa, including 15 newly described species. Two molluscan facies suggest a nearshore shallow water rock and sand substrate, and a less extensive sublittoral sandy and limy biotope. The Jalama fauna is probably of late Campanian or early Maestrichtian age. It is correlated with the uppermost Cretaceous of the western Simi Hills and the Rosario Formation from San Antonio del Mar to Ensenada, Baja California. The fauna is somewhat younger than the *Metaplacenticeras* faunas from the Santa Ana Mountains, Simi Hills, and Santa Monica Mountains.—W.O.A.

Dally, J. W. *See* Riley, W. F. 9290

Damon, Paul E. *See* Bikerman, Michael. 8973

9065 **Danner, Wilbert R.** Limestone resources of western Washington: Washington Div. Mines and Geology Bull. 52, 474 p., illus., tables, 1966.

Following a general discussion of the classification, varieties, mineralogy, origin, economics, and uses of limestone, the stratigraphy of western Washington limestones, which are Devonian to Tertiary in age, is examined. Descriptions of the geologic setting of limestone occurrences and details of deposits are given for 202 areas in 12 counties, and illustrated by 128 geologic sketch maps, 99 of which are original with this report. Devonian deposits seem to be purest, 53.90 percent, and no particular elements seemed to characterize any one limestone unit, although there is a concentration of vanadium in limestones of northwestern Whatcom County, and of Cu, Ag, and Pb in those on the east side of Orcas Island. Prospecting is most promising in areas underlain by Devonian, Pennsylvanian, or Permian rocks. Thirteen tufa deposits are listed.—E.S.L.

9268 **Dasch, M. D.** Gem materials, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 204–216, illus., 1966.

Washington gem materials are summarized alphabetically, including the better known collecting localities. For a given commodity, the localities are described in physiographic sequence, beginning with the Coast Ranges (the Olympic Mountains and the Willapa Hills) and ending with the Columbia Plateau in southeastern Washington.—W.L.G.

Davidson, E. S. *See* Brown, S. G. 8980

9306 **Davis, J. B.; Yarbrough, H. F.** Anaerobic oxidation of hydrocarbons by *Desulfovibrio desulfuricans*: Chem. Geology, v. 1, no. 2, p. 137–144, tables, 1966.

Data are presented which indicate a slow oxidation of radioactive methane, ethane, and *n*-octadecane by *Desulfovibrio desulfuricans* isolated from a fresh water oil bearing aquifer, the Carrizo (Eocene) Formation. Oxidation of *n*-octadecane by sulfate-reducer bacterial cells was indicated also by methylene blue reduction in controlled experiments. The bacteria may generate the hydrogen sulfide in the formation by coupling the oxidation of hydrocarbons to sulfate-ion reduction.—Authors' summary

Davis, M. E. *See* Leggat, E. R. 9026

9035 **Davis, Richard A., Jr.** Quiet water oolites from the Ordovician of Minnesota: Jour. Sed. Petrology, v. 36, no. 3, p. 813–818, illus., 1966.

Oolites whose perimeters are truncated at quartz grain nuclei are reported from the Ordovician of Minnesota. Sorting values of these oolites are low and their sphericity is low to moderate. The oolites are interpreted to have been formed in a low-energy environment.—G.O.B.

9140 **Davis, Stanley N.** Initiation of ground-water flow in jointed limestone, *in* Limestone hydrology—A symposium with discussion: Natl. Speleol. Soc. Bull., v. 28, no. 3, p. 111–118, illus., 1966.

Review of the limited amount of data available suggests that dense limestone, under normal conditions, is quite impervious to ground-water flow. Joints adjacent to existing bodies of water are affected by differential movement along the surfaces caused by stresses due to tidal forces, temperature changes, or distant earthquakes, the main effect of which will be to pump water in and out of the joint, and start incipient solution. Not all joints will act efficiently as pumps. Once solution enlarges the joint, water will be diverted from surrounding rocks so that the zone of most active flow, and solution, will follow the headward advance of the solution opening.—E.S.L.

9184 **Dean, Walter E., Jr.; Anderson, Roger Y.** Correlation of laminae within the Permian Castile Formation, Delaware basin, Texas and New Mexico [abs.], *in* Guidebook of Taos-Raton-Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 119–120, 1966.

Deane, Roger E. *See* Tovell, Walter M. 9470

9296 **Deboo, Phili B.** The Jacksonian-Vicksburgian boundary in the central Gulf region, *in* Facies changes in the Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. 43–45, illus., 1966.

To establish a boundary between the Jacksonian and Vicksburgian Stages in Mississippi and Alabama, and to relate it to that between the Eocene and Oligocene Series, occurrence data for three microfossil groups—ostracods and planktonic and benthonic foraminifers—differing widely in ecology were analyzed. Range data obtained from four continuously exposed sections in southwestern Alabama and one composite section in southeastern Mississippi were plotted, using a numerical index for the very diversified benthonic fauna; they form the basis of three major biostratigraphic assemblage units and two minor ones. The presence of *Cribrohantkenina inflata* within the *Spondylus dumosus* zone makes coincidence of the time- and rock-stratigraphic boundaries improbable. The assumed absence of Oligocene in the Gulf Coast appears invalid.—G.D.C.

9367 **Dellwig, L. F.; Kirk, J. N.; Walters, R. L.** The potential of low-resolution radar imagery in regional geologic studies: Jour. Geophys. Research, v. 71, no. 20, p. 4995–4998, illus., 1966.

It is shown by an example from the southern Boston Mountains of Arkansas that radar imagery of the quality and resolution of AN/APQ-69 is an excellent tool in lineament study. Despite continuing improvements in radar systems, resulting in higher resolutions and better overall quality, the geologist should not lose sight of the value of a remote sensing tool capable of detecting structures which may be indicative of the nature of the gross orogenic or epeirogenic activity.—D.B.V.

9220 **Dequasie, Henry L.** Induced polarization studies in the Great Basin province range [abs.]: Mining Eng., v. 19, no. 1, p. 63, 1967.

9286 **deVilliers, Daphne B.; vanWamelen, Diana; Strasheim, A.** Semiquantitative procedure for the simultaneous spectrographic determination of thirty elements in powder samples: Appl. Spectroscopy, v. 20, no. 5, p. 298–301, illus., tables, 1966.

The method and instrumentation described are simple, so that relatively unskilled operators can carry out the analyses and little maintenance is required. Use is made of rapid evaporation of the samples in a controlled oxygen–argon atmosphere. Line intensities are estimated visually by means of a spot densitometer. Analytical values for 10 geological samples and two refractory are tabulated, as well as the accuracy.—E.S.L.

8907 **Dineley, David.** Geological studies in Somerset Island, University of Ottawa expedition, 1965 [with French and Russian abs.]: Arctic, v. 19, no. 3, p. 270–277, illus., 1966.

Geological studies around Aston Bay and Limestone Island, Stanwell-Fletcher Lake, and Creswell Bay in Somerset Island [Northwest Territories], include the structure of the Precambrian metamorphic basement, the stratigraphy, sedimentology, and palaeontology of the Aston and Hunting formations, the Paleozoic rocks, and the younger strata north of Stanwell-Fletcher Lake. The Recent sedimentology of the lake and local Quaternary features are investigated.—Author's abstract

9291 **Dinkins, Theo H., Jr.** Subsurface stratigraphy of Claiborne County, *in* Claiborne County geology and mineral resources: Mississippi Geol. Econ. and Topog. Survey Bull. 107, p. 95–117, illus., 1966.

The subsurface stratigraphic column in Claiborne County, Miss., includes strata from the Lower Cretaceous Hosston Formation to the Bucatunna Formation of Oligocene age. The correlations are based on rock-stratigraphic units. The Lower Tuscaloosa is the most promising objective for oil and gas exploration. A structure map on the Lower Cretaceous and an isopach map of the Lower Tuscaloosa accompany the report.—E.S.L.

9458 **Dinwiddie, G. A.; Mourant, W. A.; Basler, J. A.** Municipal water supplies and uses, southwestern New Mexico: New Mexico State Engineer Tech. Rept. 29D, 98 p., illus., tables, 1966.

This report presents results of an inventory of water supplies and systems of communities with populations of 100 or more in seven counties in the southwest quadrant of New Mexico. Only ground water is used for municipal supplies because potable surface water is not generally available; most is for domestic use, lesser amounts for industrial and other uses. The most commonly used aquifers are limestones of Cambrian, Ordovician, Silurian, Mississippian, Pennsylvanian, and Cretaceous ages; Cretaceous and Tertiary volcanic rocks; Tertiary sandstones; Tertiary and Quaternary sand and gravel. Tabular data, given by county, include records of municipal wells and springs, drillers' logs, and chemical analyses. Analyses show the water to be generally acceptable for domestic use.—V.M.J.

9093 **Dinwiddie, George A.; Cooper, James B.** Water-bearing characteristics of the rocks of eastern Colfax and western Union Counties, New Mexico, *in* Guidebook of Taos-Raton-Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 76–79, 1966.

The rocks that crop out in the plains range in age from Triassic to Quaternary; most are of sedimentary origin, but some are volcanic. The Dakota Sandstone is the principal aquifer and yields adequate water for stock and domestic supplies to hundreds of wells. Other aquifers include sandstones of the Dockum Group, Entrada Sandstone, Morrison Formation, Ogallala Formation, volcanic cinders, and alluvium. Nothing is known of the water-bearing potential of rocks older than Triassic. The chemical quality of water yielded by these aquifers is suitable for most uses. Adequate quantities of ground water are available for stock and domestic use throughout the area. Wells range in depth from less than 10 to about 700 feet.—*from* Authors' summary

9350 **Dionne, Jean-Claude.** Collines pyramidales des Appalaches de l'est du Québec: Rev. Géographie Montréal, v. 20, nos. 1–2, p. 102–104, illus., 1966.

Numerous pyramidal hills are conspicuous in the dissected Appalachians of the Gaspé Peninsula between the Rimouski and Matapédia rivers. The hills are developed in massive sandstones and limestones and the dissection pattern was controlled by fractures and large joints, as revealed by a statistical study of fracture orientation. The deep dissection, which took place under climatic conditions different from those of the present, is of pre-Wisconsin age, possibly Miocene or older, and is only slightly subdued by erosion and deposition of the Wisconsin ice sheet. The hills do not resemble continental glacial features, but are similar to those formed in tropical climates (pyramidal hills of India) or in high mountains (peaks evolving from cold action).—V.M.J.

Dixon, G. H. *See* Johnson, R. B. 9212

Dobrin, Milton B. *See* Pincus, Howard. 9434

8975 **Dodd, J. Robert.** Diagenetic stability of temperature-sensitive skeletal properties in *Mytilus* from the Pleistocene of California: Geol. Soc. America Bull., v. 77, no. 11, p. 1213–1224, illus., table, 1966.

Paleotemperatures determined on the pelecypod, *Mytilus*, from five Pleistocene exposures indicate skeletal structure paleotemperatures to be least affected by diagenesis, while paleotemperatures from shell chemistry and mineralogy indicate minor changes at some sites. Oxygen isotopic compositions of the shells together with paleotemperatures can be used to determine the oxygen isotopic composition of the water in which the shells grew and hence the salinity, an indication of paleoclimate. The data suggest an interglacial origin for the four late Pleistocene localities and a cooler environment for the early Pleistocene one.—A.G.

9033 **Dodd, J. Robert.** Processes of conversion of aragonite to calcite with examples from the Cretaceous of Texas: Jour. Sed. Petrology, v. 36, no. 3, p. 733–741, illus., 1966.

Five processes of conversion of aragonite to calcite are recognized. Type 1 occurs before lithification and cavity collapse or mold formation takes place. Type 2, the most common, forms after some lithification has occurred and former voids and original skeletal material are replaced by drusy calcite. In type 3, conversion of aragonite occurs late in diagenetic history and primary pores are filled by calcite before aragonite dissolves, resulting in drusy calcite growing outward in opposite directions from a common surface. In type 4, drusy calcite may fill primary pores without lithification of matrix and solution of aragonite results in collapse. Type 5 is a conversion of aragonite to calcite without a void space.—G.O.B.

9009 **Doheny, Edward J.** Geophysics in Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 9–16, illus., 1966.

In early subsurface investigations in Indiana Logan (1930) applied magnetic anomalies to oil-field structures; Cohee (1942) described the usefulness of electric logging in correlation studies, noting records kept for about 500 oil and gas test wells. As a result of a cooperative aeromagnetic survey completed in 1950 by the U.S. Geological Survey and State of Indiana, 92 maps were published and combined

to form one regional magnetic map of the entire state. A theoretical basement-surface contour map based on 79 anomalies showed trends similar to structural trends on top of the Trenton Limestone. A regional gravity map is based on discrete points. Seismic reflection studies (1962) showed not only prominent basement layers, but also several Paleozoic reflectors.—G.D.C.

9123 **Dolan, Robert.** Beach changes on the outer banks of North Carolina: Assoc. Am. Geographers Annals, v. 56, no. 4, p. 699–711, illus., 1966.

Relationships between surf-zone processes and subaerial beach changes are considered as they occur on Bodie Island, N. C. The processes include: wave height, wave period, wave direction, and still-water level. Measurements of beach change include: beach thickness, width, and slope, as well as the size and sorting of the beach-face sediment. Analysis reveals that changes in these beach characteristics are predictable using only two of the process factors considered: wave height and still-water level. Large waves with high water levels cause rapid reductions in beach thickness, width, and slope. Small waves with low water levels are associated with thicker, wider, and steeper beaches. Sediment size and sorting show little association with the processes or beach configuration.—Author's abstract

9345 **Dolan, Robert; Ferm, John.** Swash processes and beach characteristics: Prof. Geographer, v. 18, no. 4, p. 210–213, illus., table, 1966.

Measurements of swash velocity, based on a system which times the uprush deceleration relative to an array of ground control markers, show a closer relationship to variations in beach slope than to conventional inshore wave measurements. Correlations between swash velocity and beach slope are, however, weaker under high wave conditions than when waves are smaller with longer periods. Swash velocity appears to be closely related to beach configuration and to the distribution of particle sizes over the beach-face.—Authors' conclusion

Donath, F. A. *See* Fruth, L. S., Jr. 9034

Donn, Bertram D. *See* Donn, William L. 9433

9433 **Donn, William L.; Donn, Bertram D.; Valentine, Wilbur G.** Rannyaya istoriya Zemli: Akad. Nauk SSSR Izv. Ser. Geol., no. 8, p. 24–50, illus., table, 1966.

This is a Russian translation of the work published in the Geol. Soc. America Bull., v. 76, no. 3, p. 287–306, 1965.—D.B.V.

9146 **Dorr, J. V. N., 2d.** Manganese, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 100–106, illus., table, 1966.

Manganese was first discovered in Washington in Mason County, later in adjacent parts of the Olympic Peninsula, the site of the first economic deposit, the Crescent mine. Deposits on the Olympic Peninsula are of one type and occur mostly in the Crescent Formation with some, stratigraphically below the Crescent, in a volcanic unit interbedded with the Soleduck Formation, both of Eocene age. Deposits are at or near the contact of spilites and sedimentary rocks. At the present time no informed estimate of total reserves or the magnitude of the resource is possible; the large number of scattered, small deposits indicates a considerable aggregate tonnage but complicates extraction and adds to costs of development.—W.L.G.

9126 **Dort, Wakefield, Jr.** Rapid reconnaissance of heat-flow patterns in snow-covered thermal areas: Jour. Geophys. Research, v. 71, no. 18, p. 4439–4440, illus., 1966.

Rapid reconnaissance of a snow-covered thermal area, for the purpose of identifying gross patterns and locations of abrupt changes in heat-flow intensity, can be made by plotting variations in snow depth. A pilot field study in Yellowstone National Park is reported briefly.—D.B.V.

9373 **Dort, Wakefield, Jr.** Nebraskan and Kansan stades—Complexity and importance: Science, v. 154, no. 3750, p. 771–772, illus., 1966.

Several early Pleistocene stadial tills and related soils in Kansas and Nebraska indicate a complex history of ice-sheet fluctuations. It is impossible to assign ages to individual till sheets solely on the basis of position in a stratigraphic column; all early Pleistocene correlations must be reevaluated.—Author's abstract

9365 **Dosso, H. W.** Analogue model measurements for electromagnetic variations near a coastline: Canadian Jour. Earth Sci., v. 3, no. 7, p. 917–936, illus., 1966.

An analogue model for studying behavior of the natural geomagnetic and telluric field variations for the coastline problem is discussed. Measurements of amplitudes and phases for horizontal electric, horizontal magnetic, and vertical magnetic field components for sloping earth–sea interfaces and for a sea over an upwelling conduction zone within the mantle in the form of a step are discussed for both and *E* and the *H* polarizations.—Author's abstract

Downs, Sanford C. *See* Fishman, Marvin J. 9342

Dresch, Jean. *See* Birot, Pierre. 9446

9185 **Dunlap, William H.** A progress report—What's new in the Chaveroo? [abs.], *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 120, 1966.

Dunrud, C. R. *See* Osterwald, F. W. 9199

9467 **Durham, C. O., Jr.** Louisiana's living geology, *in* Internat. Oil Scouts Assoc., 43d Ann. Mtg., Lafayette, La., July 1966, v. 7, no. 9: Austin, Tex., Internat. Oil Scouts Assoc., p. 22–26, illus., 1966.

Rates of sedimentation in the 200 m.y. old Gulf of Mexico have been increasing over the last million years. The present delta of the Mississippi River extends about 100 mi downstream from New Orleans, and was built in the last 1,000 yrs. As the area subsides under the weight of sediments, older deltas are being submerged. This process has gone on for at least 20 million years, and deltaic sediments may be 50,000 feet thick. The river valley, now filled by 300 or 400 feet of sediment, was cut at a lower sea level and ties into the submarine canyon toward the deeper part of the Gulf. The terrace above the present flood plain is an interglacial flood plain. Early sedimentation in the Gulf was a very thick layer of salt and, as the great mass of later sediments was deposited over it, salt domes formed and seemed to continue into the deep basin.—E.S.L.

Duvall, George E. *See* Ahrens, Thomas J. 9129

9422 **Dyni, John R.; Hite, Robert J.** Distribution of extractable aluminum and sodium in a saline facies of the Green River Formation, northwest Colorado [abs.]: Mining Eng., v. 18, no. 12, p. 45, 1966.

Easby, Dudley T., Jr. *See* Caley, Earle R. 9310

Eckerty, Donald G. *See* Frey, Robert W. 9011

9359 **Eddy, Gerald E.** Role of geology in state government: Michigan Geol. Survey Circ. 6, 6 p., 1966.

Douglas Houghton, the first State Geologist of Michigan, appointed in 1837, organized a broad conservation agency that faded away soon after his untimely death in 1845. A second Survey was established in 1859 but its activities were halted by the Civil War; the third Survey was authorized in 1869 and continues to serve the State as a part of the Department of Conservation. The accent is on service to the general public, the minerals industry, or to anyone requesting information. For several decades the Survey has been engaged with the U.S. Geological Survey

in a program of cooperative work, including mapping of geology of the iron ore ranges, as well as extensive geomagnetic surveys. Michigan is one of nine states in which oil and gas regulatory duties have been assigned to the state Survey, which since 1914 has been assessing metallic mineral properties also.—M.C.M.

Edhorn, A.-S. *See* Boutcher, S. M. A. 9297

9391 **Elliot, Charles L.** Free world mining geophysical activity in 1965: Mining Eng., v. 18, no. 11, p. 63–65, illus., 1966.

This is a summary of worldwide data collected by the Society of Exploration Geophysicists. By comparison with 1964, activity showed an increase of 12 percent for manpower utilization and 37 percent in terms of expenditures. Increased interest was noted for the following methods: magnetic, induced polarization, earth current, self potential, electromagnetic, radioactivity, and airborne magnetic and electromagnetic. Activity for the seismic, geochemical, and airborne radioactivity methods was about at the same level, while interest in gravity and drill hole logging methods was somewhat less.—F.C.C.

Elsik, William C. *See* Stover, Lewis E. 9006

9172 **Elsik, William C.** Biologic degradation of fossil pollen grains and spores: Micropaleontology, v. 12, no. 4, p. 515–518, illus., 1966.

Degradation patterns in the walls of Paleozoic–Cenozoic pollen grains and spores, distinctively circular and rosette to branching, cannot be attributed to oxidation or other physico-chemical processes. The smoothness and multiplicity of the small perforations are indicative of biologic activity, assumed to be fungal in nature. Spore and pollen exines may be selectively attacked and removed from the microflora.—G.D.C.

Englund, Kenneth J. *See* Huddle, John W. 9284

9390 **Ensign, Chester O., Jr.** Economic barriers delay underseas mining: Mining Eng., v. 18, no. 9, p. 59–62, 73, tables, 1966.

To develop a technology permitting profitable extraction and recovery of mineral commodities from the sea could take many years. Most mining companies would prefer to direct their research towards the development of better prospecting and mining methods applicable to the land masses—a familiar environment—where there is still great room for technological advances. Ultimately undersea mining will become a reality through the research efforts of non-mining companies such as those engaged in aerospace.—F.C.C.

9225 **Erickson, Ralph L.** Geochemical prospecting research in the Basin and Range province by the United States Geological Survey [abs.]: Mining Eng., v. 19, no. 1, p. 63, 1967.

Evans, Thomas L. *See* Gustafson, William G. 9095

9137 **Ewers, Ralph O.** Bedding-plane anastomoses and their relation to cavern passages, *in* Limestone hydrology—A symposium with discussion: Natl. Speleol. Soc. Bull., v. 28, no. 3, p. 133–140, illus., 1966.

Braided solution tubes occur in many sizes and appear to form a continuum from channels several millimeters in diameter to the spaces between the largest roof pendants. They are common in areas of poorly jointed limestone and appear on the undersides of the strata. The features extend over large areas of a bedding surface and are strongly influenced by minor fractures. Bedding-plane anastomoses are unquestionably phreatic in origin and often predate adjacent or confluent cavern passages. In many cases it appears that a cavern passage results either from an extension of the anastomoses along a route predetermined by the presence of a minute fracture or from the breaching of a stratum by growth of anastomoses from below, where two or more sets exist superimposed on adjacent bedding surfaces.—*from* Author's abstract

Ewing, Maurice. *See* Talwani, Manik. 9127

Fairchild, William W. *See* Stover, Lewis E. 9006

Fanning, Kent A. *See* Schink, David R. 8923

Fenwick, K. G. *See* Pye, E. G. 9435

Ferm, John. *See* Dolan, Robert. 9345

9231 **Fernandez, Luis María.** The determination of crustal thickness from the spectrum of P waves [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1185B, 1966.

9174 **Ferrians, Oscar J., Jr.** Effects of the earthquake of March 27, 1964 in the Copper River basin area, Alaska: U.S. Geol. Survey Prof. Paper 543-E, p. E1-E28, illus., 1966.

The closest point in this area of 17,800 sq mi in south-central Alaska to the epicenter of the 1964 earthquake is 30 mi, and the farthest point is 180 mi. Effects of the earthquake include: a broad warping with uplift and subsidence; cracking of ice in lakes and rivers; ground fracturing in areas underlain by unconsolidated deposits; snowslides, avalanches, and rockslides in the mountains surrounding the basin; and probably an overall disturbance of the glacial regimen. Property damage in the area was not great, and was restricted to the southern half of the area nearest the epicenter. No lives were lost.—O.J.F.

9417 **Fischer, William A.** Satellite detection of mineral resources [abs.]: Mining Eng., v. 18, no. 12, p. 44, 1966.

9342 **Fishman, Marvin J.; Downs, Sanford C.** Methods for analysis of selected metals in water by atomic absorption: U.S. Geol. Survey Water-Supply Paper 1540-C, p. 23-45, illus., 1966.

This manual describes atomic-absorption-spectroscopy methods for determining calcium, copper, lithium, magnesium, manganese, potassium, sodium, strontium, and zinc in atmospheric precipitation, fresh waters, and brines. The procedures are intended to be used by water quality laboratories of the Water Resources Division of the United States Geological Survey. Detailed procedures, calculations, and methods for the preparation of reagents are given for each element along with data on accuracy, precision, and sensitivity. Other topics discussed briefly are the principle of atomic absorption, instrumentation used, and special analytical techniques.—Authors' abstract

9186 **Fitzsimmons, J. Paul.** Orbicular granite of the Sandia Mountains, New Mexico [abs.], *in* Guidebook of Taos-Raton-Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 120, 1966.

9082 **Fleischer, Michael.** Index of new mineral names, discredited minerals, and changes of mineralogical nomenclature in volumes 1-50 of *The American Mineralogist*: Am. Mineralogist, v. 51, no. 8, p. 1247-1357, tables, 1966.

This paper comprises three tables as follows: (1) alphabetical index of new minerals, discredited minerals, and changes of mineralogical nomenclature; (2) classification by anionic groups; and (3) classification by elements.—E.H.R.

Fogel, M. M. *See* Matlock, W. G. 9477

9316 **Ford, Wayne T.; Hearne, James H.** Least-squares inverse filtering: Geophysics, v. 31, no. 5, p. 917-936, illus., 1966.

A matrix algebra approach is used in connection with the following problem: given the autocorrelation function of an unknown minimum-phase function, f(t), determine the minimum-phase inverse filter function, g(t), which would transform

this unknown function into a unit impulse, or some "best" approximation to a unit impulse. The presentation is abstract rather than intuitive, but detailed numerical examples are included.—D.B.V.

8989 **Forgotson, James M.** Ozark "Overthrusters" versus Ozark "Onlappers": Am. Assoc. Petroleum Geologists Bull., v. 50, no. 9, p. 2000, 1966.

It is suggested that those who believe that the rocks of the Ozark Mountains were overthrust and those who believe they were onlapped choose up sides and that each team select and core drill one or two feasible sites which it believes will prove its contentions and/or disprove the contentions of the other team. The author feels that the University of Missouri and Washington University at St. Louis, as well as the local mining companies, would support this project.—M.W.G.

Fosberg, M. A. *See* Tisdale, E. W. 9399

8899 **Foster, Norman H.** Stratigraphic leak: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2604–2606, illus., 1966.

Stratigraphic leakage is the process whereby younger fossils and/or sediments are deposited within or below older beds. This principle is important from many points of view and should receive wider attention.—S.P.S.

9386 **Foster, R. W.** Sources and properties of lightweight shale aggregates in New Mexico [abs.]: Mining Eng., v. 18, no. 12, p. 52, 1966.

9094 **Foster, Roy W.** Oil and gas exploration in Colfax County, *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 80–87, illus., 1966.

Sedimentary rocks of Cretaceous age underlie most of the plains with isolated outcrops of Triassic and Jurassic. In the mountains to the west, all strata from Precambrian upwards are exposed. Of the 39 oil tests drilled, 11 are believed to have bottomed in Precambrian. Pennsylvanian strata overlie the Precambrian in the north-central part, but in most of the county, Permian sandstones rest directly on crystalline rocks. Thickest sedimentary section drilled was in the Raton basin, 7,225 feet. Several small structures, mostly in the east, are described, and a structure contour map of the county is included. Carbon dioxide is produced from several wells, and oil and gas shows are reported.—E.S.L.

9187 **Foster, Roy W.** A regional look at the Precambrian of New Mexico [abs.], *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 120–121, 1966.

8909 **Fox, Richard D.; Groff, S. L.** Stratigraphic and structural investigations of the Cascade–Ulm area, Montana, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 36–55, illus., tables, geol. map, 1966.

The Colorado Group classification used in the Vaughn quadrangle is extended to the southeast, as the only difference is in the Flood Member of the Blackleaf; the lower sandstone unit is much thicker in the Cascade–Ulm area. The underlying Jurassic Morrison and overlying Virgell Sandstone are discussed also. Recognition of Disturbed Belt structures at the north end of the Big Belt Range is significant because it extends the margins of the Belt eastward. The greatest fault displacement is on the extension of the Carter Ranch fault which turns sharply west and splits into two parts.—E.S.L.

9117 **Fox, William T.; Ladd, John W.; Martin, Michael K.** A profile of the four moment measures perpendicular to a shoreline, South Haven, Michigan: Jour. Sed. Petrology, v. 36, no. 4, p. 1126–1130, illus., 1966.

A series of fourteen samples was taken along a profile crossing a beach, berm, foreshore slope, plunge point, nearshore, offshore bar, and offshore area to study the changes in the first four moments. The mean grain size and standard deviation reached a maximum in the plunge zone and were also high on the offshore bar. Skewness and kurtosis values were highest in the nearshore and offshore area. The beach represents a phi normal distribution of fine sand which is mixed with varying amounts of coarser material to form the sediments in the other environments.—Authors' abstract

9015 **Frarey, M. J.** Discussion—Huronian stratigraphy of the McGregor Bay area, Ontario—Relevance to the paleogeography of the Lake Superior region, by Grant M. Young [1966]: Canadian Jour. Earth Sci., v. 3, no. 7, p. 997–999, 1966.

The McGregor Bay area lies within the "southern Huronian belt" and is correlative with the original area, and not correlative with the iron formations of central Dickinson County, Michigan. Other stratigraphic correlations in Table II of Young's (ibid., v. 3, no. 2, p. 203, 1966) paper are speculative only.—M.S.T.

8931 **Fraser, J. Keith.** Francis Austin Cook (1918–1966): Arctic, v. 19, no. 3, p. 284, 1966.

9086 **French, Bevan M.** Short-range chemical variations in a manganoan axinite from the Mesabi Range, Minnesota [abs.]: Am. Mineralogist, v. 51, nos. 9–10, p. 1561, 1966.

9188 **Frenzel, Hugh N.; Ammentorp, Willis F.** The Indian Basin Upper Pennsylvanian gas field of Eddy County, New Mexico [abs.], *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 121, 1966.

Frey, Robert W. *See* Sigma Gamma Epsilon, Rho Chapter. 9002

9011 **Frey, Robert W.; Eckerty, Donald G.** Descriptions of stratigraphic units in Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 22–38, illus., 1966.

Except for Permian rocks, all Paleozoic systems are well represented in Indiana, although lowest units are not exposed. Mesozoic rocks are absent and only a few Cenozoic deposits are known. The general distribution of strata is illustrated from previously published general geologic maps, and by a stratigraphic column. Salient lithology and paleontology are described briefly and fossils listed.—G.D.C.

9012 **Frey, Robert W.** Paleontology of Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 49–64, illus., 1966.

Along the southern part of the Cincinnati arch, long a classic training ground for American paleontologists and stratigraphers, Ordovician strata are exceptionally fossiliferous. Silurian bioherms, scattered through central and northern Indiana, and prolific Devonian reefs and fossilbeds at the Falls of the Ohio are almost equally appealing. A Mississippian bioherm at Crawfordsville has yielded well-preserved crinoid specimens which appear in museums around the world, and diminutive fauna of the Salem Limestone was noted as early as 1858. The western part of the state has abundant Pennsylvanian plant fossils. No Permian or Mesozoic rocks are known in Indiana, but Quaternary deposits are locally rich in mollusks and have yielded excellent mastodon specimens. Distinctive features and distribution of typical forms are briefly described.—G.D.C.

9408 **Fridel, R. A.** Infrared in coal structure research, *in* Applied infrared spectroscopy: New York, Reinhold Publishing Corp., p. 312–343, illus., tables, 1966.

Infrared spectroscopy has played an important part in the investigation of coal structure since 1945; coals of the same rank from different places have similar spectra. For studies of solid coals, three techniques have been used: ground thin

sections, mulls, and halide pellets. Spectral assignments are tabulated and shown on graphs, and some individual bands are described. Spectral intensity gives quantitative information, as illustrated by that obtained from some absorption bands for Pittsburgh vitrain. Infrared work on extracts and distillates, reaction products, and chars of model compounds and effects of photolysis, irradiations of several types, and electric discharges on coal structure are examined. Other studies reviewed include microbiology, sorption properties, and charge-transfer complexing. Types and sizes of aromatic structures also have been studied by infrared spectroscopy.—E.S.L.

9072 **Friend, Peter Furneaux.** Clay fractions and colours of some Devonian red beds in the Catskill Mountains, U.S.A.: Geol. Soc. London Quart. Jour., v. 122, pt. 3, p. 273–288, illus., tables, 1966.

The fine fractions of samples from a cyclothemic section in the Catskill facies, Appalachian region, have been analyzed by X-ray diffraction and determinations of iron content made. All samples contain both illite and chlorite, and some contain kaolinite. Two cyclothems are richer throughout in kaolinite. This is attributed to change in provenance and demonstrates the relative unimportance of diagenetic alteration of the clays. The redness is due to fine-grained hematite, much of it in hexagonal crystalline form. The clay content does not vary with the red or non-red state of the rocks, and this color differentiation did not therefore involve alteration of the clays. A hypothesis to explain the red-non-red differentiation within the cyclothems is put forward [result of differences in oxidation-reduction potential determined by position of water-table].—*from* Author's abstract

9079 **Frondel, Clifford; Ito, Jun; Hendricks, John G.** Barium feldspars from Franklin, New Jersey: Am. Mineralogist, v. 51, nos. 9–10, p. 1388–1393, tables, 1966.

Celsian, hyalophane, and barian varieties of both microcline and anorthoclase have been identified in a silicate skarn zone at Franklin. Chemical analyses with optical and X-ray powder data are given for hyalophanes and for celsian. The microcline and anorthoclase in general contain much less barium and are formed earlier than the monoclinic hyalophane.—*from* Authors' abstract

9083 **Frondel, Clifford; Ito, Jun.** Zincian aegirine-augite and jeffersonite from Franklin, New Jersey: Am. Mineralogist, v. 51, nos. 9–10, p. 1406–1413, tables, 1966.

Jeffersonite has been classed as a diopsidic pyroxene, but four new chemical analyses (with accompanying X-ray and optical data) establish that it comprises highly zincian and manganoan members of a series from aegirine-augite to sodian and ferrian augite. Both divalent manganese and zinc are much in excess of ferrous iron. As ferric iron and sodium decrease the color changes from brown to dark olive green and greenish black. The original jeffersonite of Vanuxem and Keating (1822) probably referred to the latter material; the name lacks species or varietal significance and may be set aside.—*from* Authors' abstract

8921 **Frost, N. H.; Lilly, J. E.** Crustal movement in the Lake St. John area, Quebec [with French abs.]: Canadian Surveyor, v. 20, no. 4, p. 292–299, illus., tables, 1966.

Results of releveling by the Geodetic Survey of Canada indicate that crustal movement has taken place since the lines were first run 30 or 40 yr ago. A large circular area in Laurentides Park has settled a maximum of 0.5 ft, and there is uplift of 0.8 ft on the west side of the lake and 0.5 ft on the east side. Two new level lines are being established in the area for future releveling.—E.S.L.

9034 **Fruth, L. S., Jr.; Orme, G. R.; Donath, F. A.** Experimental compaction effects in carbonate sediments: Jour. Sed. Petrology, v. 36, no. 3, p. 747–754, illus., 1966.

Experimental compaction of modern carbonate sediment from five Bahamian facies has produced spalling of oolite borders, grain interpenetration, fractures, and other features found in natural limestones. These features can be related to sediment type, and to pressure, compaction, and porosity conditions. Most of the sediment types tested show a marked initial compaction below about 30 bars pressure, but above 350 bars the compaction curves are nearly parallel. Even with large differences

in initial and final porosity, all show approximately 35 percent porosity at 120 bars pressure; the porosity decreases with increasing pressure.—Authors' abstract

Gager, W. B. *See* Sclar, C. B. 9436

Galuska, George R. *See* Radella, Frank A. 8937

Ganapurthy, R. *See* Kuroda, P. K. 9429

8913 **Gardner, J.** Geomorphic studies in the alpine zone: Canadian Alpine Jour., v. 49, p. 173–178, illus., 1966.

Physical processes of weathering and erosion, rates at which these are altering the present mountain landscape, and landforms they are producing were studied during the summer of 1965 in the Lake Louise district, as a preliminary survey for long-term measurement of mass movement in the Canadian Rockies. Four forms of scree or talus are distinguished: cone, sheet, scalloped apron (intermediate between first two), and an amorphous form consisting of "mountain-top detritus"; these are further differentiated by component materials. Other slope deposits observed were: avalanche debris slopes, rockfall or landslide deposits, and deposits of slightly rounded rock fragments showing effects of water action. An inventory was kept of all movements contributing to mass wasting on the slopes; in 30 recording days, 290 movements were directly observed.—V.M.J.

Garrison, Louis E. *See* McMaster, Robert L. 9054

Gedney, Larry D. *See* Ryall, Alan. 9287

9244 **Gerhard, F. Bruce, Jr.** The crystal structure of the mineral pachnolite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1229B, 1966.

9143 **Ghiselin, Michael T.** The adaptive significance of gastropod torsion: Evolution, v. 20, no. 3, p. 337–348, illus., 1966.

Theories which explain torsion in gastropods are critically evaluated. The theory of Lang, as modified by Naef, provides a satisfactory functional explanation, that torsion made it easier for an elongate or coiled shell to be dragged about; however, the hypothetical ancestors envisaged make little sense as organisms. The theory of Garstang, that torsion protected the larval head and velum, is unsatisfactory because it provides no adaptive intermediates and must rely on a saltation. In view of the coiled larval shell in the non-torted *Neopilina*, it is suggested that torsion arose in a limpet-like form, and was selected because it helped the coiled larva to balance its shell during settling.—*from* Author's summary

9282 **Giles, G. C.** Potential waterpower, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 366–370, illus., table, 1966.

The waterpower resources of Washington at developed and undeveloped sites are summarized in a table. Where powersites are located on boundary streams between States, half of the potential power is assigned to each State. Although 3,558 MW of potential waterpower resources are estimated to be available for development throughout the State, it is expected that further investigations of these sites will result in a substantial reduction of the potential because of economic feasibility, unfavorable geologic conditions, conflicting interests in land or water uses, and adverse effects on existing cultural developments.—W.L.G.

9038 **Ginsburg, R. N.; Bernard, H. A.; Moody, R. A.; Daigle, E. E.** The Shell method of impregnating cores of unconsolidated sediments: Jour. Sed. Petrology, v. 36, no. 4, p. 1118–1125, illus., 1966.

A method of impregnating increments of 3-inch diameter cores of unconsolidated sediment is described. It consists of vacuum and pressure impregnation with polyester resin of dried cores. After the resin jells and cures overnight, the cores can be slabbed with a diamond saw.—E.D.M.

Giovanella, C. A. *See* Wynne-Edwards, H. R. 9226

9320 **Glawe, Lloyd N.** An evolutionary trend observed in *Pecten perplanus* Morton, *in* Facies changes in the Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. 46, 1966.

In the abundantly "pecteniferous" Oligocene formations at St. Stephens, Ala., a sequential change in the population proportions of morphological variants of this species is noted. Rib sculptural development from smooth to unilirate to trilirate forms are recognized in large samples from successively younger beds. At St. Stephens both left and right valves exhibit this trend; westward to Louisiana and eastward to central Alabama, a similar trend is recognized in right valves. However, west of Sylvarena, Miss., where equivalent beds are more detrital, sculptural development on left valves does not follow a sequential trend.—G.D.C.

9302 **Gleeson, C. F.** (compiler). Silver content of stream and spring sediments, Keno Hill area, Yukon Territory: Canada Geol. Survey Prelim. Ser. Map 46-1965, scale 1:126,720, text, 1966.

The Keno Hill area is underlain by a series of metamorphosed sedimentary rocks, mainly quartzites, phyllites, slates, chlorite, sericite and graphite schists; their age is uncertain but appears to range from Precambrian to Mesozoic. The area has undergone several stages of glaciation; thick glacial deposits occupy the major valleys and hill slopes below an elevation of 3,000 feet. Permafrost is present throughout the area. Most of the lead-silver ore deposits in the Keno-Galena Hills area occur along northeasterly striking vein faults in quartzite and occasionally in greenstone. Data on the map are based on 5,900 samples of stream sediment collected from an area of about 1,900 sq mi. Preliminary results indicate most of the known lead-zinc-silver deposits have silver anomalies associated with them.—M.C.M.

9303 **Gleeson, C. F.** (compiler). Zinc content of stream and spring sediments, Keno Hill area, Yukon Territory: Canada Geol. Survey Prelim. Ser. Map 47-1965, scale 1:126,720, text, 1966.

The general geology of the Keno Hill area is covered in the abstract for Map 46-1965 (Gleeson, 1966). There are many areas on the map containing zinc in stream sediments greater than 190 ppm; some of the high values are associated with known lead-zinc-silver deposits and others are a result of contamination from mine workings. Many of the high values occur in areas that to date have been little explored. In some acid-water streams zinc anomalies may be displaced several thousand feet downstream from their sources. Further follow-up work is warranted.—M.C.M.

9304 **Gleeson, C. F.** (compiler). Arsenic content of stream and spring sediments, Keno Hill area, Yukon Territory: Canada Geol. Survey Prelim. Ser. Map 48-1965, scale 1:126,720, text, 1966.

The general geology of the Keno Hill area is covered in the abstract for Map 46-1965 (Gleeson, 1966). In this district arsenic is high in areas intruded by granitic rocks, clearly illustrated by the numerous high values found in sediments of Dublin Gulch and Mount Haldane. Sediments of streams neighboring most of the known lead-silver deposits and gold-arsenopyrite-pyrite veins have high arsenic values, although some creeks are high because of contamination from mine workings. Anomalous trains vary in length from less than 1/2 to 4 mi. Arsenic may be more widespread in some areas than previously thought; further follow-up work is warranted.—M.C.M.

9400 **Goodman, Lou R.** Effects of blockage on soda straw stalactites: Cave Notes, v. 8, no. 4, p. 25-31, illus., 1966.

Soda-straw type stalactites are produced entirely by internal flow, blockage of which may be by external bypass or by air influx. Changes in the growth pattern caused by entry of air into the soda straw, such as growth of a miniscus form, or tube-wall penetration causing bulbous or carrot-shaped outgrowths, are described and illustrated.—E.S.L.

9085 **Goodman, Richard E.; Appuhn, Richard A.** Model experiments on the earthquake response of soil-filled basins: Geol. Soc. America Bull., v. 77, no. 11, p. 1315–1326, illus., 1966.

The motion of soil filling a model bedrock basin was observed during continuous vibration on a laboratory shaking table. Factors that varied include: thickness and consistency of soil, ratio of basin length to width, and frequency and amplitude of vibration. Amplitude of soil displacement increased with increasing soil thickness or increased softening of soil consistency. When soil consistency became very soft, a reverse effect occurred.—A.G.

9203 **Goreau, T.; Burke, Kevin.** Pleistocene and Holocene geology of the island shelf near Kingston, Jamaica: Marine Geology, v. 4, no. 3, p. 207–225, illus., 1966.

Present-day distribution of coral reefs, coral cays, banks, and gravel spits on the island shelf, suggests that these are superimposed upon an old erosional surface with a base level at approximately 40 m below modern sea level, which was subsequently modified by partial burial under the Liguanea gravel fan. Many cays and patch reefs seem to be built upon erosional remnants, whereas the main barrier reef veneers part of an old gravel spit deposited on the –40 m surface. This ridge parallels the trend of the modern Palisadoes spit and has no obvious relation to morphology of the underlying platform; indeed it bridges the deepest feature of the area, an 80 m deep submarine valley cut into the edge of the island shelf. The authors believe that this gulch was eroded into the –40 m surface during an extreme low stand of the sea.—*from* Authors' abstract

9204 **Gorsline, D. S.** Dynamic characteristics of west Florida Gulf Coast beaches: Marine Geology, v. 4, no. 3, p. 187–206, illus., tables, 1966.

During 1962, 15 beach stations were established and monitored at monthly intervals. Observations of beach profiles, sediments, wave conditions, water characteristics, and wind speed and direction were recorded for comparison of this low- and medium-energy environment with a high-energy environment in California. Most beaches along this coast appear to be in equilibrium; beach, terrace, and bar sands have strikingly uniform textures; and net transport, to the west, is progrâding large spits in the Mobile Bay–Pensacola area.—E.S.L.

9058 **Gottardi, Glauco.** X-ray crystallography of rinkite: Am. Mineralogist, v. 51, nos. 9–10, p. 1529–1535, illus., 1966.

Rinkite from Kangerdluarssuk, Greenland, has been X-rayed to resolve the controversy over its symmetry. If strong reflections only are considered, rinkite appears to be orthorhombic, but if weak reflections are also considered or if long exposure films are examined, it is monoclinic with *b* as the unique axis. Schematic drawings of the (hO1) plane of the reciprocal lattice show that rinkite is definitely monoclinic with space group $P2_1/m$ or $P2_1$. These results exclude a (100) polysynthetic twin which would exhibit orthorhombic symmetry in X-ray films. Smallest unit cells outlined by a continuous line are coded I or II alternately. Cells with different code numbers are very similar but not equal, and, therefore, identity periods must be changed to produce a cell with at least double volume as in unitary monoclinic type 1 or 2, or a fourfold volume as in doubly primitive monoclinic cell.—V.S.N.

9450 **Gould, Stephen Jay.** Allometry and size in ontogeny and phylogeny: Cambridge Philos. Soc. Biol. Rev., v. 41, no. 4, p. 587–640, illus., tables, 1966.

Allometry is defined as the study of proportional changes correlated with variations in size of either the total organism or the part under consideration. The variates may be morphological, physiological, or chemical; the size differences may arise in ontogeny, phylogeny, or static comparison of related forms. Some observed allometric patterns are explained as adaptations which produce altered proportions to maintain or improve physiological efficiency in modified size ranges during the course of ontogeny and phylogeny. Allometric parameters are important in taxonomy as well as evolution. Application of allometry to geographical and

geomorphological relations is discussed briefly. Factor analysis has shown promise in the area of multivariate methods which consider allometry.—G.D.C.

8976 **Govett, G. J. S.** Origin of banded iron formations: Geol. Soc. America Bull., v. 77, no. 11, p. 1191–1211, illus., tables, 1966.

Primary accumulations of iron could not have occurred in a marine environment, and a closed or lacustrine-type environment is favored. A key point is the density and chemical stratification, with periodic mixing, that exists in such environments and which allows periodic high iron concentrations to develop. Known limnological processes are thus invoked to explain iron accumulations and rhythmic banding of iron and silica. The lower alumina content of Precambrian versus later oolitic iron formations is linked to change in character of the Earth's crust and the development of biotic systems in later time.—J.J.H.

9044 **Govindaraju, K.** Rapid flame photometric determination of sodium and potassium in silicate rocks: Appl. Spectroscopy, v. 20, no. 5, p. 302–304, illus., tables, 1966.

The sample is fused with a suitable fusion agent ($H_3BO_3+Li_2CO_3$) and the ground fusion product is dissolved completely in dilute citric acid. The analysis of this solution for alkalies does not indicate any matrix effects. Comparison of results with available rock standards shows good accuracy and reproducibility. This method is used to supplement spectrographic determination of major constituents in silicate rocks, using borate fusion techniques, and has been used for the analysis of more than 5,000 rock samples.—*from* Author's abstract

Gower, H. D. *See* Beikman, H. M. 9279

Grant, Richard E. *See* Cooper, G. Arthur. 9476

Grantham, R. G. *See* Leach, S. D. 9027

9415 **Grass, Richard I.** The geology structure-stress relationship at the White Pine mine [abs.]: Mining Eng., v. 18, no. 12, p. 44, 1966.

9196 **Gray, R. J.; Schapiro, N.** Petrographic composition and coking characteristics of Sunnyside coal from Utah, *in* Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, p. 55–79, illus., tables, 1966.

This Upper Cretaceous, high-volatile bituminous, marginal coking coal ranges in rank from A to B. In the mining area sampled, the petrographic composition is relatively uniform, both vertically and laterally. The coal contains 68 to 79 percent vitrinoids with average reflectance (in oil) of 0.70 percent. Its low fluidity, non-swelling nature, and poor fusion under normal coking conditions are due to low degree of metamorphism of the vitrinoids. It is highly susceptible to oxidation.—G.D.C.

9197 **Gray, R. J.; Patalski, R. M.; Schapiro, N.** Correlation of coal deposits from central Utah, *in* Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, p. 81–86, illus., 1966.

Coal deposits of central Utah are extremely variable in thickness of beds and distance between zones, and, thus, extent and quality of reserves are difficult to estimate in the field. To correlate zones by laboratory methods, identification of fossil spore and pollen exines was used in coal samples from nine drill holes to divide the complex coal sequence into three distinct zones, which roughly correspond to zones identified tentatively by field geologists from intervals and geologic sequence. Exine types are illustrated and frequency of occurrence in one drill core figured. An expanded stratigraphic profile of Ferron Sandstone Member of Mancos Shale is given on the coal-zone correlation chart.—G.D.C.

8981 **Gray, Roe A.** Memorial to John P. Hurndall (1902–1966): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 9, p. 2011, portrait, 1966.

Green, L. H. *See* Roots, E. F. 9327

Gregory, A. F. *See* Wynne-Edwards, H. R. 9226

9149 **Griggs, A. B.** Geology—Columbia Basin, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 22–27, illus., 1966.

The Columbia Basin occupies most of the areas east of the Cascade Range to the Idaho border and south from the east-west course of the Columbia River and its tributary, the Spokane River, to the Oregon border. It is a structural basin which formed gradually under the load of floods of basaltic lava in Miocene to Pliocene time. Maximum lava thicknesses are 5,000 feet, although one thickness of 10,665 feet is known. Locally warping of the flows produced basins and anticlinal arches. The loess soils are the most valuable resource, and make the basin a great grain-producing area. Clays are used for refractory and common brick and are a potential alumina source. Vesicular and fractured lava flows are the chief aquifers and the principal ground-water source.—V.S.N.

8911 **Griscom, Andrew.** Geology of the Ripogenus Lake area, Maine [with Trip BF road log], *in* Guidebook for field trips in the Mount Katahdin region, Maine—New England Intercollegiate Geol. Conf., 58th Ann. Mtg. 1966: [Augusta, Maine, Maine Geol. Survey] p. 36–41, illus., 1966.

This area is on the northeast limb of a northwest-trending anticline that is structurally unique in northern Maine because its axis strikes normal to regional Appalachian trends. The oldest rocks in the center, possibly Cambrian, are tightly folded, intruded by Ordovician mafic dikes and gabbro plutons. Above these, with profound unconformity, lie fossiliferous Lower Silurian rocks, well exposed near the Ripogenus Dam where they are about 700 feet thick. A thick sequence of andesitic lava flows overlies the basal sandstones and limestones which are intruded by three associated sills; in the upper part red siltstone and shale grade upward into dark-gray slates and the subgraywackes correlated with Lower Devonian strata. Intrusion of the Katahdin quartz monozonite batholith followed Acadian folding of these Paleozoic rocks.—G.D.C.

8940 **Griscom, Andrew.** Early ascents and geologic exploration of Katahdin in the nineteenth century, *in* Guidebook for field trips in the Mount Katahdin region, Maine—New England Intercollegiate Geol. Conf., 58th Ann. Mtg. 1966: [Augusta, Maine, Maine Geol. Survey] p. 4–7, illus., 1966.

Upstream between the East and West Branches of the Penobscot River lie the highest mountains in Maine. Reports of early surveys (1700–1900) are briefly reviewed; descriptions of geology vary as well as estimates of height. The problem of the ice sheet overtopping Katahdin was settled by Ralph S. Tarr (1900). Little information was obtained from that time until 1950, when research by graduate students of Harvard University was begun in this region, as discussed by other papers in this guidebook.—G.D.C.

Groff, S. L. *See* Fox, Richard D. 8909

9135 **Gross, E. B.; Heinrich, E. William.** Petrology and mineralogy of the Mount Rosa area, El Paso and Teller Counties, Colorado—[Pt.] 3, Lamprophyres and mineral deposits: Am. Mineralogist, v. 51, nos. 9–10, p. 1433–1442, tables, 1966.

Widely scattered dark gray lamprophyre dikes in the Mount Rosa area strike generally north-northwest and dip steeply. Outcrops of the lamprophyres can usually be traced for less than 500 feet, range in width from 2 to 25 feet, and are of two types—sodic syenites and sodic diorites. They intrude Pikes Peak granite, its variants, and Mount Rosa-type pegmatites, and are believed to be of late Precambrian age; their period of intrusion overlapped that of Mount Rosa-type pegmatites. Veins of fluorite strike mainly north or northeast and dip steeply. These are probably of Tertiary age. Strongly radioactive altered zones in Mount Rosa granite contain uranothorite and thorogummite, which also occur as late hydrothermal minerals in Mount Rosa-type pegmatites.—*from* Authors' abstract

9369 **Gross, M. Grant; Nelson, Jack L.** Sediment movement on the continental shelf near Washington and Oregon: Science, v. 154, no. 3751, p. 879–880, 885, illus., 1966.

The nuclides zinc–65 and cobalt–60 associated with river–borne particulate matter are incorporated in sediment on the Continental Shelf near the Columbia River. Changes in the relative concentrations of zinc–65 and cobalt–60 and in the ratio of the activity of zinc–65 and cobalt–60 suggest that radioactive sediment moves northward 12 to 30 km per year along the shelf and 2.5 to 10 km per year westward away from the coast.—Authors' abstract

Gualtieri, James L. *See* Carter, William D. 9285

9357 **Guillou, R. B.** Parr area (ARMS–II): U.S. Atomic Energy Comm. Civil Effects Study CEX–63.6.2, 20 p., illus., table, 1966.

The area consists of a 100–mi square centered on the Carolinas–Virginia Nuclear Power Associates facility near Parr, S. C. Data are presented as aeroradioactivity units at two map scales: generalized at about 1:1,000,000 and detailed at 1:250,000. Maximum counting rates were less than 400 cps in about one–fourth, less than 800 cps in about one–half, less than 1,200 cps in about one–fourth, and less than 2,500 cps in about one–tenth the area. Aerial measurements of ground radioactivity were consistent with what was expected, considering the geology of the area. Rocks of the Carolina slate belt produced low counting rates, and the complex metamorphic and igneous geology of the Piedmont produced complex aeroradioactivity units. Artificial radionuclides were probably present in only small quantities.—*from* Author's abstract

9358 **Guillou, R. B.** Orlando area (ARMS–II): U.S. Atomic Energy Comm. Civil Effects Study CEX–63.6.1, 19 p., illus., table, 1966.

The survey area consists of the land portion of a 100–mile square centered on the Kennedy Space Center, Fla. Data are presented as aeroradioactivity units at two map scales: generalized at about 1:1,000,000 and detailed at 1:250,000. Maximum aeroradioactivity in almost all the area was less than 400 cps. In a few small areas along the east coast, the maximum counting rate was 500 cps. Aerial measurements of ground radioactivity were consistent with what was expected, considering the geology of the area. Artificial radionuclides were probably present in only small quantities because background gamma radioactivity was less than 200 cps in many places.—*from* Author's abstract

9314 **Gupta, Indra Z.** Standing waves in a layered half space: Seismol. Soc. America Bull., v. 56, no. 5, p. 1153–1161, illus., table, 1966.

In a homogeneous elastic half space, plane harmonic waves give rise to standing waves only when on reflection there is no conversion from one wave–type to another. The existence of standing waves in a horizontally–layered half space is established for vertically propagating plane harmonic P, SV or SH waves. Expressions are derived for the particle displacements at the free surface and at any given depth. The layered system acts as a complicated filter suppressing certain periods while amplifying others. The results obtained may be helpful in an understanding of the "ground factor", ambient seismic body–wave noise, and vibration problem of a structure due to earthquake motion.—Author's abstract

9095 **Gustafson, William G.; Bryant, Donald G.; Evans, Thomas L.** Geology of the Questa molybdenite deposit, Taos County, New Mexico, *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 51–55, illus., table, 1966.

The Questa molybdenite deposit is located in a side canyon of the Red River, on the west slope of the Taos Range. The range is underlain by Precambrian metamorphic rocks and a Tertiary complex of volcanics and intrusives. Both vein and stockwork deposits are found in and adjacent to the Sulfur Gulch stock. Seventeen hydrothermal minerals have been identified in the Questa deposit; the

alteration and mineralization are discussed. A geologic sketch map is included.—E.S.L.

9283 **Hack, John T.** Interpretation of Cumberland Escarpment and Highland Rim, south-central Tennessee and northeast Alabama: U.S. Geol. Survey Prof. Paper 524-C, p. C1-C16, illus., tables, geol. map, 1966.

The relations between bedrock and topography characteristic of this region are used to compare alternative geomorphic interpretations of the Appalachian Highlands. One, based on the Davis geographic cycle, supports three cycles of base leveling separated by periods of uplift which warped and led to dissection of the peneplains. The other (Hack, 1960) holds that the landscape formed by continuous lowering of the surface involving slope retreat on beds of different resistance; the landscape is adjusted to processes acting now or in the recent past. This latter thesis is in accord with present conditions and "is supported by the distribution and character of surficial deposits, which are adjusted to the outcrop pattern of the rocks now exposed."—V.S.N.

9385 **Hadzeriga, Pablo.** Dynamic equilibria in the solar evaporation of the Great Salt Lake brine [abs.]: Mining Eng., v. 18, no. 12, p. 51, 1966.

Hagan, Wallace W. *See* Bodkin, Hillard W. 8904

Hahn, Glenn W. *See* Allen, William B. 9344

8933 **Hall, Bradford A.** Stratigraphy and structure of the Chamberlain Lake region, Maine [with Trip BS road log], *in* Guidebook for field trips in the Mount Katahdin region, Maine—New England Intercollegiate Geol. Conf., 58th Ann. Mtg. 1966: [Augusta, Maine, Maine Geol. Survey] p. 42-50, illus., table, 1966.

This area occupies part of the southeast limb of the northeast trending Munsungun anticlinorium of Hall (1964). The core of the structure is occupied by Cambrian(?) rocks, followed by a thick volcanic sequence of Middle Ordovician, Upper Silurian, and Lower Devonian rocks. The bedrock is differentiated into eleven mappable units of which only the Seeboomoo formation (Devonian) is referred to by name. These units, described in the table, are indicated on geologic sketch maps. There are three angular unconformities within the section, rocks were folded and a regional cleavage and chlorite grade metamorphism developed during the post-Devonian Acadian orogeny. Except in the Cambrian(?) rocks, earlier deformations in this area were not that intense.—G.D.C.

9219 **Hall, Stephen A.** *Lingula* in the Wellington Formation (Permian) of Oklahoma: Oklahoma Geology Notes, v. 26, no. 10, p. 258-259, 1966.

Numerous specimens of the brachiopod *Lingula* occur in a roadside cut near the intersection of U.S. Highway 64 and Interstate 35 in Noble County, Okla. The valves are concentrated in a two-inch zone in a red shale near the top of the Midco Member. Their presence indicates a definite connection with a marine environment at least once during Wellington time.—E.S.L.

8997 **Halstead, E. C.; Treichel, A.** Groundwater resources of the coastal lowland and adjacent islands, Nanoose Bay to Campbell River, east coast, Vancouver Island [with French, German and Russian abs.]: Canada Geol. Survey Bull. 144, 42 p., illus., tables, 1966.

Permeable sand and gravel constitute adequate recharge areas and storage reservoirs for large volumes of good quality ground water in eastern Vancouver Island, British Columbia. Some of these permit ground water movement ranging from 1,000 to more than 40,000 gpd per ft of aquifer. Where unconsolidated deposits are thin, lacking, or impermeable, water is obtained from underlying shale, sandstone, and conglomerate. Ground water is transmitted along bedding planes or fractures; only wells that encounter such openings are productive. Rain provides adequate recharge, but seasonal variations complicate the problem of maintaining supplies in shallow dug wells. A map showing probable extent of aquifers and well records accompanies the report.—E.S.L.

9202 **Hamblin, W. K.; Rigby, J. Keith.** (Manuscript Committee). Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, 164 p., illus., tables, 1966.

Central Utah has excellent Upper Cretaceous exposures in which continental, littoral, and marine strata can be traced continuously for nearly 200 miles. Sedimentary environments include shallow marine off-shore zone, barrier bars, beaches, lagoons, and associated terrestrial flood plains. From Provo to Price outcrops of Price River Conglomerates are excellent in Spanish Fork Canyon and also in Price River Canyon along with North Horn and Blackhawk Formations. Near Price the coal-bearing rocks are well exposed, and underground sequences can be seen in Sunnyvale Mine No. 3. Individually cited papers deal with various problems in stratigraphy, coal deposits, and geologic history.—G.D.C.

9098 **Hamilton, Warren; Myers, W. Bradley.** Cenozoic tectonics of the western United States, *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-14, p. 291-306, illus. [1966].

Cenozoic structure of western United States is the result of oblique rifting and fragmentation of continental crust. Coastal California and Baja California have slid nearly 500 km northwestward, opening the Gulf of California. The San Andreas is limited to continental crust, which is moving over the mantle. Oblique extension with lesser right-lateral faulting produced normal faults of the Basin and Range. Pre-Tertiary rocks of northern California and Oregon have pulled away from those of Nevada and Idaho and the gap filled by Cenozoic volcanics. The Snake River Plain is a lava-filled rift produced in the lee of a drifting continental plate. Cenozoic volcanic terrane of northwestern Oregon and southwestern Washington represents new crust, formed on older oceanic crust undergoing compressive deformation due to lateral motion of continental masses bounding it.—*from* Authors' abstract

8994 **Han, Tsu-Ming.** Textural relations of hematite and magnetite in some Precambrian metamorphosed oxide iron formation [abs.]: Am. Mineralogist, v. 51, nos. 9-10, p. 1961-1962, 1966.

9469 **Hand, Bryce H.** Amherst's low-cost flume: Geotimes, v. 11, no. 1, p. 17-18, illus., 1966.

For the past year, geology students and staff at Amherst College, Amherst, Mass., have been using a flume designed and built by the staff at a cost of about one thousand, eight hundred dollars. It is used in connection with elementary classes for the course on sedimentology, and for research by advanced students. The flume, and its construction, are described, and a photograph is included.—E.S.L.

Handin, John. *See* Borg, Iris. 9069

Hanshaw, Bruce B. *See* Back, William. 9139

9043 **Harlton, Bruce H.** Reply [to discussion, by R. S. Tarr, 1966, of "Relation of buried Tishomingo uplift to Ardmore basin and Ouachita Mountains, southeastern Oklahoma," 1966]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1519, 1966.

Sole faulting probably occurs in the imbricate northwestern border within five miles of the Ouachita Front, and the root of this faulting is within the geosyncline. The main concern here is to delineate and establish the framework of a major interregional pattern on the basis of subsurface and seismic data. Harlton considers rocks above the Womble in a well in T. 1 N., R. 14 E., and south of the Ouachita Front, as lithologically similar to rocks of the same age in the Ardmore basin. However, the Womble Formation in this well seems to be a deep basinward development of the Simpson Formation.—M.W.G.

9455 **Harrer, C. M.** Wyoming iron-ore deposits—Description, beneficiation processes, and economics: U.S. Bur. Mines Inf. Circ. 8315, 114 p., illus., tables, 1966.

Resources of iron in Wyoming estimated to be many hundreds of million tons are mostly in magnetite taconite of Precambrian age but partly in other kinds of deposits and in rocks as young as Cretaceous. Two deposits are the source of most of the 32,500,000 tons of combined ore and concentrates produced through 1965. Brief descriptions of these and other deposits, analyses of samples, results of concentrating tests, and a review of economic factors related to iron mining are included.—A.P.B.

9041 **Harrington, Horacio J.** Reply [to discussion by J. R. Patterson, of "Space, things, time, and events—An essay on stratigraphy," 1966]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1521–1523, 1966.

Patterson's belief (ibid., p. 1519–1520) that unconformities and disconformities are basic concepts of stratigraphic correlation is attributed to the influence of outmoded ideas of Lyell and Stille. The paleontologist has a privileged position in matters of stratigraphy, and therefore Harrington places the Tremadocian in the Ordovician on basis of paleontology.—M.W.G.

Harris, F. R. *See* Pye, E. G. 9435

Harris, William L. *See* Silverman, Arnold. 8919

9312 **Harrison, Christopher G. A.** Antipodal location of continents and oceans: Science, v. 153, no. 3741, p. 1246–1248, illus., 1966.

The percentage of continent antipodal to ocean on the Earth is compared with a distribution obtained by a Monte Carlo method. It is concluded that the present antipodal arrangement of continents and oceans has less than 1 chance in 14 of being caused by a random process.—Author's abstract

9050 **Hartmann, Burt E.** Rock mechanics instrumentation for tunnel construction: Wheatridge, Colo., Terrametrics, Inc., 153 p., illus., 1966.

Basic information obtained during rock mass, or joint, mechanics studies is applied to problems of excavation, construction support, and linings. Measurements discussed include rock mass movements; geologic factors such as fractures, alteration, and ground water; geophysical surveys; and rock material tests. Instrumentation systems described are surface and shallow-embedded instruments, borehole extensometers and deflection indicators, opening deformation instruments, and load and stress cells. Application of the data to control of safety factors and design criteria, and a section on writing specifications are included.—E.S.L.

9463 **Hashimoto, Tsutomu; Béland, René.** A graphical explanation of the common absence of hematite in metamorphic silicate iron formations: Naturaliste Canadien, v. 93, no. 4, p. 367–369, illus., 1966.

Magnetite, rather than hematite, is the common iron oxide mineral in metamorphic silicate iron-formations. The plotting of the compositions of ferrous silicates in a FeO-MgO-Al_2O_3-Fe_2O_3 tetrahedron suggests a possible explanation. A three-phase field, aluminum silicate-magnesium silicate-magnetite, may provide a partial barrier between ferrous silicates and hematite, and block off tie lines between the FeO region and the Fe_2O_3 apex of the tetrahedron.—Authors' abstract

Hastie, L. M. *See* Savage, J. C. 9432

Hatchett, J. L. *See* Randich, P. G. 9364

9366 **Hatfield, Craig B.; Rohrbacker, Timothy J.** Dolomite-insoluble residue relationships in the Ten Mile Creek Dolomite (Middle Devonian) near Toledo, Ohio: Jour. Sed. Petrology, v. 36, no. 3, p. 828–831, 1966.

Analyses of 70 samples of the Ten Mile Creek Dolomite show complete lack of correlation of dolomite/calcite ratios with percent insoluble residue, percent clay minerals, identity of clay minerals, or percent silica. Earlier reports of direct correlations between percent dolomite and percent insoluble residue in some carbonate rocks need not reflect a cause-and-effect relationship between insoluble

content and proportion of dolomite. Several reported occurrences of modern dolomite strongly suggest a primary or penecontemporaneous origin independent of quantity or quality of terrigenous detritus. Surely many ancient dolomites similarly reflect an environment of deposition rather than a secondary origin related to the mineralogy of associated clastics.—Authors' abstract

9389 **Hausen, D. M.** Fine gold occurrence at Carlin, Nevada [abs.]: Mining Eng., v. 18, no. 12, p. 52, 1966.

9189 **Havenor, Kay C.** Geologic problems of a portion of the Roswell artesian basin, Chaves County, New Mexico [abs.], *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 121, 1966.

Hay, P. W. *See* Wynne-Edwards, H. R. 9226

9017 **Hayes, Miles O.** Some observations on the geological effects of hurricanes, south Texas coast: Houston Geol. Soc. Bull., v. 9, no. 1, p. 18–26, illus., 1966.

A 60-mile segment of coast south of Corpus Christi, Tex., was studied before and after hurricane Carla, Sept. 1961. The bottom of the inner neritic zone both contributed and received hurricane deposits. The storm picked up shells, rock fragments, etc., from depths to 80 feet and deposited them on the barrier, Padre Island. After the storm passed, strong currents spilled out of channels cut into the island by the storm-surge, and deposited a thin layer of sand out to a depth of 60 feet, and a turbidite further out. The storm removed a belt of foredunes 20 to 50 yards wide from the seaward side of Padre Island and left the foredune ridge with wave-cut cliffs up to 10 feet high. Formation of a broad, flat hurricane beach drastically altered the profile. A much milder storm, Cindy, Sept. 1963, deposited a small swash bar over the seaward edge of the pre-existing hurricane beach.—*from* Author's abstract

9056 **Hays, James Fred.** Stability and properties of the synthetic pyroxene $CaAl_2SiO_6$: Am. Mineralogist, v. 51, nos. 9–10, p. 1523–1529, tables, 1966.

Pyroxene of the composition $CaAl_2SiO_6$ is synthesized from glass above 1050°C and 12 kb. The refractive indices are: $\alpha = 1.709$, $\beta = 1.714$, $\gamma = 1.730$. X-ray patterns are indexed to the diopside structure; $a = 9.619$ A, $b = 8.659$ A, $c = 5.278$ A, $\beta = 73.86°$, $V = 422.3$ A^3, $\rho = 3.431$ g/cc. Microprobe analysis yields a composition close to the ideal formula. This phase is stable relative to anorthite+gehlenite+corundum (lower p) and to corundum+grossular (higher p, lower T); the high pressure, high temperature, and absence of Fe, Mg needed for its stability explain its absence in nature.—E.Z.

9111 **Heald, M. T.; Renton, J. J.** Experimental study of sandstone cementation: Jour. Sed. Petrology, v. 36, no. 4, p. 977–991, illus., 1966.

In an artificial environment of 225° to 360°C under pressures of 2,000 to 11,000 psi, circulating solutions of NaOH, $NaCO_3$, and K_2CO_3 duplicate reasonably well natural conditions which produce silica cement in the form of overgrowths in quartz sand. Factors which control rates of cementing include size and shape of quartz grains, proportions of monocrystalline and polycrystalline grains, grain shape, sorting, proportions of non-quartz grains, and restrictions on circulation of the solutions. Concentrated solutions or rapid influx of solution favors formation of microcrystalline cement along with overgrowths. Strength of cemented aggregates depends on size, shape and proportions of quartz grains, and on proportions of overgrowth and microcrystalline cements.—R.A.C.

9224 **Healy, John H.** Earth's crust and upper mantle in the United States [abs.]: Mining Eng., v. 19, no. 1, p. 63, 1967.

Hearne, James H. *See* Ford, Wayne T. 9316

9379 **Heath, Michael T.** Mineralization of the Silver Star stock, Skamania County, Washington [abs.]: Mining Eng., v. 18, no. 12, p. 47, 1966.

9230 **Heckel, Philip Henry.** Stratigraphy, petrography, and depositional environment of the Tully Limestone (Devonian) in New York State and adjacent region [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1185B–1186B, 1966.

8993 **Heinrich, E. William; Vian, Richard W.** A barite–quartz phase in the Firesand River carbonatite, Wawa, Ontario [abs.]: Am. Mineralogist, v. 51, nos. 9–10, p. 1562, 1966.

Heinrich, E. William. *See* Gross, E. B. 9135

Heirtzler, J. R. *See* Talwani, M. 9110

Hendricks, John G. *See* Frondel, Clifford. 9079

9229 **Hergenroder, John David.** The Bays Formation (Middle Ordovician) and related rocks of the southern Appalachians [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1186B, 1966.

9023 **Herreid, Gordon.** Preliminary geology and geochemistry of the Sinuk River area, Seward Peninsula, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 24, 19 p., illus., tables, geol. map, 1966.

Geology and soil and stream sediment geochemistry of the Sinuk River gossan area were mapped; the map area is underlain by marble and schist. Two deposits located along a schist–marble contact contain well-exposed disseminated galena–zinc–fluorite mineralization associated with silicified schist; adjacent to them strong soil anomalies indicate concentrations of zinc and lead of possible economic significance. Other deposits are limited to exposures of gossan rubble in areas underlain by marble, are probably localized along faults, and contain only background amounts of copper, lead, zinc, and molybdenum. The Monarch prospect contains anomalous amounts of zinc and lead and represents an interesting exploration target. Deposits have similarities to the Illinois–Kentucky fluorspar district which could be an aid in understanding their geology.—*from* Author's abstract

8999 **Hess, David F.** Economic geology of Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 82–92, illus., 1966.

Indiana is endowed with a variety of minerals and mineral resources, the stratigraphic distribution of which is described, along with past and present utilization and miscellaneous information of general interest. In 1964, coal from Pennsylvanian rocks was the most important commodity; after cement materials and stone, petroleum and natural gas ranked fourth. Iron, chiefly concretionary goethite, was processed from 1834 to 1895; glacio–fluvial gold has been recovered and is presently panned as a tourist attraction; other metallic nuggets are of mineralogical interest. At least 30 diamonds and a few other gemstones have been found in glacial drift, but the source in Canada has not been located.—G.D.C.

9010 **Hess, David F.** Basement rocks in Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 17–21, illus., 1966.

The character and composition of Precambrian basement rocks in Indiana long conjectured has been put on a more solid footing by deep wells and detailed geophysical studies. A regional red granite has been encountered in northwestern Indiana in addition to the more statewide basalt and metasediments of greenschist facies that have been described. A deep well in Lawrence County has penetrated greenstone basalt below the metasediments, the mineralogy of which suggests Keweenawan flows. A problem of integrating geophysical, lithologic, petrographic, and regional tecto[illegible] is reflected in the positioning of the western Grenville Front in the midwestern [illegible] ...-cut position on the basis of absolute age-dating may not be feasible.—G.D.C.

9052 **Hewitt, W. P.** Pennsylvanian and Permian basins in northwestern Utah, northeastern Nevada and south-central Idaho—Discussion [of paper by R. J. Roberts and others, 1965]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1523, 1966.

Hewitt credits C. L. Thornburg, R. D. Rubright, and W. H. Smith of U.S. Smelting Refining and Mining Co. with the original recognition of the Midas thrust fault and the solution of the displacement problem. For reasons of company policy their findings were long suppressed [see Roberts et al, ibid., v. 49, no. 11, p. 1926–1956, 1965).—M.W.G.

9281 **Hidaka, F. T.** Water resources, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 311–355, illus., tables, 1966.

This report deals with the State's water resources, the quantity, quality, and distribution, and their use for municipal water supply. Areas where ground water commonly contains more than 250 ppm of dissolved-solids or has hardness exceeding 120 ppm are shown in figures. Calcium and bicarbonate are the principal ions in most ground waters. Notable exceptions to these characteristics are described and discussed for the following areas: Hoh River, Grays Harbor, Puget Sound, Lewis River, Yakima River, Scabland, Palouse, Walla Walla, Chelan, Okanogan, and Clark Fork.—W.L.G.

9106 **Hill, Mason L.** The San Andreas system, California and Mexico, *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–14, p. 239–245, illus. [1966].

The surface trace of the San Andreas fault is a 500 mi lineament resulting from Recent ground movements. The zone comprises those faults which parallel, and are connected to, the San Andreas fault. These right-lateral slip faults and some east-northeast trending left-slip faults of the Garlock set comprise the San Andreas system which is a strain system of north-south shortening and east-west extension with local upward relief. There have been several tens of miles of slip since Miocene time and perhaps several hundreds since the Cretaceous. As far as the north end of the Gulf of California, the zone is a shear structure, but if it extends farther southeast, it may become a rift with a right-slip component commensurate with post-Mesozoic displacement in California. A relatively northward moving upper mantle current along the western margin of the continent may be responsible for the fault system.—*from* Author's abstract

9328 **Hill, Walter S., Jr.; Neuman, Robert W.** Copper artifacts from prehistoric archeological sites in the Dakotas: Science, v. 154, no. 3753, p. 1171–1173, table, 1966.

Thirteen archeological specimens were analyzed spectrographically, and within defined limits they were determined to be native copper. Twelve of the specimens show close elemental homogeneity and are believed to be of Lake Superior ore; the origin of the other specimen is devious.—Authors' abstract

9228 **Himmelberg, Glen Ray.** Precambrian geology of the Granite Falls–Montevideo area, Minnesota [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1187B, 1966.

Hite, Robert J. *See* Dyni, John R. 9422

9259 **Hobbs, S. W.** Tungsten, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 150–157, illus., table, 1966.

Tungsten occurrences are reported from 14 counties in the State, but aside from Stevens County the only other localities that have yielded noteworthy amounts are in Ferry and Okanogan Counties. Total production for Washington through 1962 is 4,000 tons of 60 percent WO_3 concentrates, most of which came from Stevens County. Included in the report is a table summarizing the available information

on most of the localities in the State that are more than mere mineral occurrences.—W.L.G.

9343 **Hoffman, C. M.; Stewart, G. L.** Quantitative determination of tritium in natural waters: U.S. Geol. Survey Water-Supply Paper 1696-D, p. D1-D18, illus., tables, 1966.

This report describes the methods and procedures used by the United States Geological Survey Tritium Laboratory to analyze natural waters for tritium activity. Samples having low activity are electrolytically enriched in cells with nickel and steel electrodes, and their tritium concentration is subsequently determined by liquid scintillation and gas phase counting techniques. Samples having high tritium concentrations can be counted directly, and no enrichment is required. Theory, calculations, equipment, and procedures are described in some detail.—Authors' abstract

Holland, Charles T. *See* Olsen, David A. 9384

9419 **Holmer, Ralph C.** Progress in techniques for mineral exploration [abs.]: Mining Eng., v. 18, no. 12, p. 44, 1966.

9022 **Hood, J. W.** (and others). Developing a state water plan—Ground-water conditions in Utah, spring of 1966: Utah Water and Power Board Coop. Inv. Rept. 4, 95 p., illus., tables, 1966.

This report is the third in a series, and contains information on well construction, ground-water withdrawals, water-level changes, and related changes in precipitation or streamflow as well as supplementary data related to ground-water use in some individual areas by individual authors for the calendar year of 1965. Inclusion of graphs showing chemical quality of water and maps showing water-table slope is intended only for those years or areas where applicable data are available and are important to a discussion of changing ground-water conditions. Water-level fluctuations are described for the period spring 1965 through spring 1966.—*from* Author's introduction

9238 **Hood, Peter.** Geophysical reconnaissance of Hudson Bay—Pt. 1, Sea-magnetometer survey; Pt. 2, Subbottom depth recorder survey: Canada Geol. Survey Paper 65-32, 42 p., illus., 1966.

A total of 6,500 nautical miles of sea-magnetometer data was obtained, and total intensity values are presented in the form of profiles. A quantitative interpretation shows that depths to basement are least around the margin of Hudson Bay, with greatest depth, over 10,000 feet, in the center. An asymetrical trough-like feature in the northeast corner may be a graben formed by northwest trending faults. Sedimentary rocks in the Bay are much thicker than had been supposed, the thickest section being where the water is deepest. Ten continuous subbottom depth recorder profiles were obtained also. Interpretations for three in the Belcher Islands area, as shown on an accompanying map, indicate tight folding. Two profiles in the central part were unclear, but the remainder, located north of Churchill, indicate gently north-dipping Paleozoic sediments.—E.S.L.

Hopkins, David M. *See* Scholl, David W. 9007

9437 **Hopkins, W. B.; Tilstra, J. R.** Availability of ground water from the alluvium along the Missouri River in northeastern Montana: U.S. Geol. Survey Hydrol. Inv. Atlas HA-224, scale 1:96,000, separate text, 1966.

The Missouri River valley in northeastern Montana is carved into the Bearpaw Shale, Fox Hills Sandstone, and Hell Creek Formations (Late Cretaceous), and the Paleocene Fort Union Formation; it has been partly filled with extensive deposits of unconsolidated material. Surficial material consists of clay and silt at most locations. Ground water readily available to wells occurs in sand and gravel strata of the alluvium; supplies are affected by recharge, movement, and discharge. Ground water used for irrigation is classified as C3 or C4 water; high salinity and excessive sodium and bicarbonate concentration make accumulation of salts in the

soil a hazard unless drainage is adequate to permit considerable leaching and careful management of water is practiced. High concentrations of iron, sulfate, and total dissolved solids affect adversely the water for domestic supply.—M.C.M.

9227 **Horstman, Arden William.** Correlation of the Lower and lower Upper Cretaceous rocks of a part of southwestern Wyoming, Utah, and Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1187B, 1966.

Hose, R. K. *See* Roberts, Ralph J. 9045

9032 **Hoskin, Charles M.** Coral pinnacle sedimentation, Alacran Reef lagoon, Mexico: Jour. Sed. Petrology, v. 36, no. 4, p. 1058–1074, illus., 1966.

Coral pinnacles in Alacran Reef lagoon can be characterized by three different depositional environments: (1) pinnacle crest, area of living stony corals and poorly sorted unconsolidated sediment; (2) pinnacle slope, a transitional environment with poorly sorted gravelly coral; (3) lagoon floor, with poorly sorted fecal pellet silt. Diagenetic processes include pelleting of lagoon floor mud, formation of galleries in coral framework by boring algae, growth of enhedral aragonite crystals in grain cavities, and recrystallization of coral grains. Expected diagenetic processes are cementation and dolomitization of pinnacle crest sand, compaction of lagoon, floor mud, and mold porosity formation in all environments.—G.O.B.

9264 **Hosterman, J. W.; Livingston, V. E., Jr.** Clays, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 177–185, illus., tables, 1966.

"Clays mined in Washington have a variety of actual or potential uses, but probably two-thirds of all clays consumed in the State are used for the manufacture of ceramic products." A table is included in this report, listing many of the clay deposits, and summarizing the physical, chemical, and ceramic properties of the clay. Other pertinent data also are given, including reference to reports in which the deposits have been described.—W.L.G.

9403 **Housner, George W.** Reporter's summary—Theme 2, Analysis of structural response, *in* World Conf. on Earthquake Engineering, 3d, New Zealand, 1965, Proc., V. 2: Wellington, New Zealand Inst. Engineers, p. II-1—II-20, 1965 [1966].

Housner summarizes the contributions of the 61 papers (11 abstracts) presented at session two of this conference under the following main topics: nonlinear response of engineering structures, calculated response of elastic structures, dynamic properties of particular structures, experimental determination of dynamic properties, and vibration analyses of structures. The greatest need in the field of structural response to earthquake ground motion is for experimental research on a greatly increased scale.—V.S.N.

8971 **Howard, J. H.** Structural development of the Williams Range thrust, Colorado: Geol. Soc. America Bull., v. 77, no. 11, p. 1247–1263, illus., geol. maps, 1966.

A thrust fault in Middle Park, Colo., is observed to be curved, being nearly horizontal in its westernmost exposures and having progressively steeper eastern dips toward the east. The thrust is known to have experienced recurrent movement. An explanation is offered for an average cross section, and analysis is treated as a two-dimensional problem. The system presented consists of a combination of two systems of stress. One is characterized by a step displacement of the midpoint of the lower boundary, and the other by a cosine displacement of the lower boundary. The system accounts for the altitude of faulting in the average cross section and predicts fault development where faulting has occurred.—J.P.A.

9195 **Howard, James D.** Characteristic trace fossils in Upper Cretaceous sandstones of the Book Cliffs and Wasatch Plateau, *in* Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, p. 35–53, illus., 1966.

Absence of abundant body fossils in some of the Upper Cretaceous near-shore marine sandstones of the Western Interior is compensated for by copious trace fossils. Trace fossils, although less studied than fossil shells and tests, can be useful in paleo-environmental studies because they are usually facies fauna and, unlike preserved hard parts, only rarely can they be transported or reworked. This paper mentions 20 common trace fossils found in Upper Cretaceous rocks of the Wasatch Plateau and Book Cliffs of east-central Utah and subdivides them on the basis of wave and current energy in the environment of deposition.—Author's abstract

9201 **Howard, James D.** Sedimentation of the Panther Sandstone Tongue, *in* Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, p. 23–33, illus., 1966.

Howard reevaluates his previous interpretation and classifies this basal member of the Cretaceous Star Point Formation, well exposed in the Book Cliffs and northern Wasatch Plateau, as a composite deltaic sequence of fine-grained clastic facies. Highly mottled gray siltstones of the bottomset beds grade into very fine-grained, matrix-rich, foreset sandstones. Delta-front deposits and fluvial-channel sandstones make up the topset beds. Capping most of the foregoing deposits is a wedge-shaped body, a small-scale repeat of the Panther Tongue.—G.D.C.

9008 **Howard, James F.; Balthaser, Lawrence H.** Paleozoic sedimentation and stratigraphy in Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 39–49, 1966.

Surface exposures in Indiana are early Mohawkian or younger in age, except in the Kentland dome area, where Ordovician strata as old as Late Canadian are exposed. This structural uplift produced a stratigraphic displacement of more than 1,500 feet within a distance of three miles. From detailed studies by geologists from Wisconsin, Missouri, Illinois, and Indiana, brief descriptions of units and facies in each system, including deep-well data on the Cambrian, are compiled and their geographic distribution given, as well as some of the better known hypotheses of deposition.—G.D.C.

9335 **Hsu, K. Jinghwa.** Origin of dolomite in sedimentary sequences—A critical analysis [with German abs.]: Mineralium Deposita, v. 1, no. 2, p. 133–138, illus., 1966.

Certain chemical conditions must have been fulfilled and certain hydrological framework must have prevailed when large bodies of sedimentary dolomites were formed. This paper discusses the chemistry of dolomite formation, and analyzes quantitatively the movement of subsurface waters and the relation of flow rate to dolomitization. The geologic environment favorable for dolomitization could be interpreted in terms of chemistry and/or hydrology. No new hypothesis of dolomitization is presented, only the minimum conditions necessary for dolomite formations are defined.—Author's abstract

8903 **Hubbert, M. King.** History of petroleum geology and its bearing upon present and future exploration: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2504–2518, illus., 1966.

According to industry statistics, the United States passed the peak in its rate of oil discovery about 1957, and the peak in its proved reserves at about the end of 1960. The history of petroleum geology began with formulations of the anticlinal accumulation of oil in 1861. The period 1910–1935 was a period of inquiry into basic questions of origin, migration, and entrapment of oil and gas, followed by a period of stagnation based on the illusion that the answers to fundamental problems were known. During recent years renewed inquiry concerning the physics of the rock-water-oil system showed that stable accumulations of oil and gas are possible in plunging noses, structural terraces, homoclinal dips, and even in deep structurally negative parts of geosynclinal basins.—W.C.C.

9284 **Huddle, John W.; Englund, Kenneth J.** Geology and coal reserves of the Kermit and Varney area, Kentucky: U.S. Geol. Survey Prof. Paper 507, 83 p., illus., tables, geol. maps, 1966.

The Kermit and Varney areas, about 109 sq mi of coal-bearing rocks of Pennsylvanian age in Pike and Martin Counties, Ky., were mapped because of indicated large reserves of undeveloped bituminous coal. Geologic and structure maps for each quadrangle were made by field and photogeologic mapping. Seven stratigraphic sections prepared from core and sample descriptions, measured sections, and drillers' logs show the lithology and persistence of rock units. Twelve coal beds contain reserves of high-volatile bituminous coal in beds more than 14 inches in thickness. The Kermit quadrangle is estimated to contain original reserves of about 489 million short tons of coal in beds more than 14 inches thick, the Varney to contain about 861 million tons. Remaining reserves in beds thicker than 28 inches amount to about 480 million tons.—*from* Authors' abstract

9404 **Hunter, Ralph E.** Heavy minerals in sands along the Wabash River: Illinois Geol. Survey Circ. 402, 22 p., illus., tables, 1966.

The heavy fractions of sands along the Wabash River consist primarily of hornblende and garnet, heavy rock fragments, and magnetite, ilmenite, hematite, and other titanium-bearing minerals. Most of the 30 samples taken from Illinois terrace deposits of glacial outwash, recent river bars, and sand dunes, have 1 to 3 percent heavy minerals in the 35- to 270-mesh size range. Ilmenite ranges from about 0.02 to 0.3 percent, and the TiO_2 content is estimated between 0.01 and 0.17 percent. Such percentages are much less than for Florida sands that are being mined for titanium, although those of finer size grades are closer. More difficult mineral separation problems in the Wabash Valley sands and uncertain marketable by-products make their commercial value questionable.—G.D.C.

9261 **Huntting, M. T.** Alunite, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 167-175, 1966.

"Most of the alunite so far found in the State of Washington is just beneath thick layers of silicified rock. The wide distribution of silicified rock and clay mineralization strongly suggests that more alunite-rich rock could be found by further exploration."—W.L.G.

9272 **Huntting, M. T.** Peat, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 235-240, illus., table, 1966.

In recent years, Washington has ranked among the top three or four States in peat production, and there may be as much as 100,000 or more acres of peat land in the State. The peat deposits, examined by Rigg (1958) are distributed among six of the seven physiographic provinces in the State although by far the greatest number are in the Puget Sound province. Deposits are listed in a table and locations are shown on a map. W. S. Moen and G. W. Thorsen (1965) report that in 1964 peat was being produced from 32 deposits, and sphagnum peat from at least 3 deposits.—W.L.G.

9273 **Huntting, M. T.** Pumice, pumicite, volcanic cinders, and perlite, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 240-245, illus., 1966.

The pumice of Washington is from two volcanoes: Mount St. Helens, and Glacier Peak, both of which are in the Cascade Mountains and are Pleistocene to Recent in age. The perlite deposits are in volcanic rocks ranging in age from Eocene to Recent and have acidic to intermediate composition. They are mostly in the Cascade Mountains and their foothills. Volcanic cinders have been produced on a small scale from four deposits in southcentral part of the State. The pumicite deposits are mostly in the eastern part of the State and range in age from late Miocene or Pliocene to Recent. These deposits are briefly discussed.—W.L.G.

8920 **Hussey, Keith M.; Michelson, Ronald W.** Tundra relief features near Point Barrow, Alaska [with French and Russian abs.]: Arctic, v. 19, no. 2, p. 162–184, illus., tables, 1966.

The distribution of minor tundra relief patterns shows that topography plays a leading part in their development. In extensive areas of very low relief, local expression may well exceed the regional range. Aside from the initial relief, the greatest deviations from a flat surface in the Barrow area are related to the growth or thaw of ground ice. This leads to such features as high- and low-centered polygons, ice-wedge troughs, ice-cored mounds and thaw basins of all sizes. The genesis of most of these features has been determined. However, it has been questioned that the basins could have been formed by thaw. Specimens of the frozen ground were collected and analyzed to determine their relative ice content. The values were extrapolated, and it was found that even the largest basins can be true thermokarst features.—Authors' abstract

Ito, Jun. *See* Frondel, Clifford. 9079

Ito, Jun. *See* Frondel, Clifford. 9083

Jackson, S. A. *See* Beales, F. W. 9464

Jambor, J. L. *See* Boyle, R. W. 9322

9212 **Johnson, R. B.; Dixon, G. H.; Wanek, A. A.** Late Cretaceous and Tertiary stratigraphy of the Raton basin of New Mexico and Colorado, *in* Guidebook of Taos-Raton-Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 88–98, illus., 1966.

A thick sequence of Upper Cretaceous and Tertiary sedimentary rocks is preserved in the Raton basin. These include the Pierre Shale, Trinidad Sandstone, and Vermejo Formation, Cretaceous; the Raton Formation, Cretaceous and Paleocene; the Poison Canyon Formation, Paleocene; the Cuchara and Huerfano Formations, Eocene; the Farisita Conglomerate, probable Oligocene; and the Devil's Hole Formation, probable Miocene. Locally Laramide deformation began with epeirogenic movements west of the Raton basin in late Montana time. These were followed by at least seven orogenic episodes, as shown by angular unconformities and lithologic changes. Sills, dikes, plugs, stocks, sole injections, and laccoliths were intruded into the sedimentary rocks of the basin during the Eocene.—*from* Authors' abstract

9321 **Joiner, Thomas J.; Moore, Donald B.** Structural features in south Alabama, *in* Facies changes in the Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. 11–19, illus., 1966.

Within the Gulf Coastal Plain in southeast Alabama the Tertiary formations dip from 10 to 30 feet per mile nearly due south. Westward the direction of dip changes to south-southwest, but the rate remains about the same. Considered here is the influence of the deep-lying Louann Salt of Jurassic age in southwest Alabama, and the basement of igneous, metamorphic, and Paleozoic rocks. The most prominent structural features within this part of the salt basin—the Hatchetigbee anticline, the Jackson fault-Klepac dome, the Mobile graben, and the Gilbertown, Pollard and Bethel fault zones, and other structures—are described briefly. Projection of major fault zones from the Piedmont area into southern Alabama and their relation to east-west facies changes within the uppermost Cretaceous and Tertiary formations are illustrated.—G.D.C.

9112 **Jopling, Alan V.** Some deductions on the temporal significance of laminae deposited by current action in clastic rocks: Jour. Sed. Petrology, v. 36, no. 4, p. 880–887, illus., 1966.

Time required to form a lamina in a sediment may be a matter of seconds, hours, days, or years. Rate of formation varies with the depositional environment. In environments where deposition takes place from suspensions, as in lakes or the deep

sea, laminae form in days or years. Where there is deposition of bed load sediment by glacial streams, turbidity currents, sand storms or ocean storms, or volcanic ash falls, laminae form in seconds. Estimating elapsed time from the number of laminae requires interpretations of rate of formation of the laminae. Because of the diastemic nature of sediments, the number of preserved laminae can only yield estimates of minimum time represented by a laminated sedimentary bed.—R.A.C.

Julian, B. *See* Anderson, Don L. 9326

9318 **Kaarsberg, Ernest A.** Determination of the elastic constants of an isotropic solid using a "plate" velocity measurement: Geophysics, v. 31, no. 5, p. 984–986, illus., 1966.

It is shown briefly how the elastic constants of an isotropic solid can be determined with the aid of longitudinal infinite "plate" velocities.—D.B.V.

9071 **Kanasewich, E. R.** Deep crustal structure under the plains and Rocky Mountains: Canadian Jour. Earth Sci., v. 3, no. 7, p. 937–945, illus., 1966.

A modified form of Pratt's hypothesis of isostasy is applied to continental regions of the United States and Canada, in view of the fact that the crustal root of the Rocky Mountains is 30–50 km thick as compared with 40–55 km for much of the plains. Crustal studies in the plains and mountains indicate that more consideration should be given to gravitational gliding tectonics in the development of the Rocky Mountain system, since it is possible that there was substantial vertical motion of the larger crustal blocks.—M.S.T.

9242 **Karklins, Olgerts Longins.** Cryptostome Bryozoa from Middle Ordovician Decorah Shale of Minnesota [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1187B–1188B, 1966.

Keil, Klaus. *See* Buseck, Peter R. 9077

9361 **Keller, Olive A.** (compiler). Bibliography of U.S. Geological Survey water resources reports for Utah: Utah State Engineer Inf. Bull. 17, 37 p., tables, 1966.

The bibliography, containing a complete listing to December 1966 of reports relating to the water resources of Utah prepared by personnel of the U.S. Geological Survey, includes: publications of the Geological Survey, publications by agencies of the State of Utah (State Engineer, Geological and Mineralogical Survey, and Water and Power Board), publications by other agencies or in professional journals, and open-file reports of the Geological Survey. All items in the bibliography are indexed by county and the entire state.—*from* Author's introduction

9407 **Kendall, David N.** (editor). Applied infrared spectroscopy: New York, Reinhold Publishing Corp., 560 p., illus., tables, 1966.

The volume is composed of 18 papers by 21 contributors, one of which (by R. A. Fridel) is cited separately. The applications covered concern principally empirical infrared absorption spectroscopy applied to problems arising in the fields of chemistry, physics, and biology. The background material on which the method is based has been treated only briefly, since more detailed treatments are available; references to the latter are given.—E.S.L.

9243 **Kerns, Raymond LeRoy, Jr.** Structural charge site influence on the interlayer properties of expandable three-layer clay minerals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1230B, 1966.

9177 **Kimyai, Abbas.** New plant microfossils from the Raritan Formation (Cretaceous) in New Jersey: Micropaleontology, v. 12, no. 4, p. 461–476, illus., 1966.

In an investigation of plant microfossils from the Raritan Formation of New Jersey, U.S.A., two new genera and thirty-six new species are described. The climate during Raritan time ranged from subtropical to temperate. The age of the Raritan Formation is considered to be the earliest Late Cretaceous. The presence of marine

microfossils suggests a shallow-water marine environment for this formation.—Author's abstract

King, Chi-Yu. *See* Liebermann, Robert C. 9131

9162 **King, R. U.** Molybdenum, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 109–116, illus., table, 1966.

Very little molybdenum has been produced in Washington, but a number of deposits of potential economic importance are scattered across the Northern Cascade Mountains and northeastern Washington. A figure shows the location of 59 deposits of molybdenum for which some reliable data are available and illustrates their distribution and mode of occurrence. Brief descriptions of the occurrences are given in a table.—W.L.G.

Kirchmayer, Martin. *See* Larson, Leonard H. 8970

Kirk, J. N. *See* Dellwig, L. F. 9367

Kister, L. R. *See* Brown, S. G. 8980

9075 **Kittrick, J. A.** Free energy of formation of kaolinite from solubility measurements: Am. Mineralogist, v. 51, nos. 9–10, p. 1457–1466, illus., tables, 1966.

The free energy of formation of seven kaolinite samples ranged from -902.5 to 903.8 kcal per mole, in general agreement with X-ray diffraction indications of crystallinity. Measurements were made over a wide range of common ion activities and are in relatively good agreement with those based upon heat of solution measurements and estimations from natural relationships. Ion activities supported by a few kaolinite samples appear to be controlled by relatively soluble small particles that can be removed by chemical extractions or centrifuging.—Author's abstract

8898 **Kohls, Donald W.; Seewald, Clyde R.** Surficial deposits overlying Simsboro Formation of northeast-central Texas: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2606–2611, illus., table, 1966.

Surficial deposits overlying the Simsboro Formation are unconsolidated and not typically bedded but do have a podzol soil profile. However, analysis shows these deposits are not residual soils but lag deposits derived from the Simsboro, younger Tertiary formations, and Quaternary terrace deposits.—S.P.S.

Koons, G. J. *See* Ruotsala, A. P. 8991

9059 **Krause, Dale C.; Chramiec, Mark A.; Walsh, George M.; Wisotsky, Serge.** Seismic profile showing Cenozoic development of the New England continental margin: Jour. Geophys. Research, v. 71, no. 18, p. 4327–4332, illus., 1966.

A new seismic profiling system (hydroacoustic transducer with correlation receiver) has yielded a detailed profile of the outer continental margin off New England which shows new evidence of Cenozoic sedimentation and shallow geologic structure. Two major reflectors are tentatively identified as early Tertiary and Pliocene–Pleistocene in age. There is evidence of 850 m of subsidence since early Tertiary time. The shelf edge and shoreline have migrated northward because the sediment supply has not been sufficient to build up the continental shelf and slope to compensate for the relative regional subsidence.—D.B.V.

9241 **Krawiec, Wesley.** Recent sediments of the Louisiana inner continental shelf [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1188B, 1966.

Kuroda, P. K. *See* Rowe, M. W. 9356

9429 **Kuroda, P. K.; Rowe, M. W.; Clark, R. S.; Ganapurthy, R.** Galactic and solar nucleosynthesis: Nature, v. 212, no. 5059, p. 241–243, illus., table, 1966.

Investigation of a dozen meteorites shows that almost all fit an isochron corresponding to the Pu–244—Xe–136 formation interval (Xi = 300 m.y.), whereas the values of the I–129—Xe–129 formation interval tend to scatter more or less randomly within the range 100–300 m.y. These rather striking results are interpreted on the basis of the postulate that Pu–244 is synthesized in the supernova explosion, while I–129 can be synthesized in the solar as well as in the galactic nucleosynthesis processes.—D.B.V.

Ladd, John W. *See* Fox, William T. 9117

8974 **LaFehr, T. R.** Gravity in the eastern Klamath Mountains, California: Geol. Soc. America Bull., v. 77, no. 11, p. 1177–1189, illus., table, 1966.

A positive gravity anomaly, 20×80 km, located south of Yreka, Calif., is believed caused by an ultramafic intrusion serpentinized at very shallow depth. The maximum amplitude of the residual anomaly is about 50 mgal, the maximum gradient is 6.6 mg/km, and the average half width is 8.5 km. A calculated anomalous mass per unit length is 23×10^{10} g/cm with a maximum depth of 4 km.—R.G.Y.

9101 **Lambert, Wayne.** Notes on the late Cenozoic geology of the Taos–Questa area, New Mexico, *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 43–50, illus., 1966.

The Taos–Questa area forms the southeastern part of the San Luis basin. Basin-fill deposits make up the Santa Fe Group, Miocene–Pleistocene, three formations of which are exposed. Six of the major volcanic centers from which basalts of the younger Servilleta Formation came, are described. The San Luis basin has been lowered several thousand feet, and basin-margin and intra-basin faults are the principal structures. The Rio Grande trough, in the eastern half of the area, originated in late Miocene. Principal geomorphic features are the piedmont landforms and the Rio Grande gorge.—E.S.L.

9330 **LaMoreaux, Philip E.** Foreword, *in* Facies changes in the Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. iii–iv, 1966.

Geologic trips of this type are an important mechanism for communication of geologic information related to the source and availability of water, minerals, oil and gas. Tertiary formations in the Gulf Coast area contain a large part of the nation's reserves of oil and gas, are a potential source of raw materials, and include some of the most prolific aquifers in the United States. Investigations in this area, one of the first to be studied geologically in the United States, are summarized briefly.—G.D.C.

9468 **Lane, N. Gary.** New Harmony and pioneer geology: Geotimes, v. 11, no. 2, p. 18–20, 22, illus., 1966.

The small village of New Harmony, in southwestern Indiana, is of prime historical significance for early geological studies in the Midwest. Headquarters for two of the earliest federally sponsored geological surveys were in this town for about 20 years. William Maclure, Gerard Troost, David Dale Owen, F. B. Meek, E. T. Cox, and B. F. Shumard were all associated with New Harmony; their contributions are reviewed, with a more detailed account of Owen's work. Five of the men associated with New Harmony were at one time state geologists for seven Midwest states.—E.S.L.

Lane, Richard A. *See* Sigma Gamma Epsilon, Rho Chapter, 9002

9451 **Lange, Arthur L.** On stalactites vs. cylindrical draperies—[Discussion of "Effects of blockage on soda straw stalactites," by L. R. Goodman, 1966]: Cave Notes, v. 8, no. 5, p. 37, 1966.

When Goodman (ibid., v. 8, no. 4, p. 25–31, 1966) writes of 'stalactites without a central tube,' he is reflecting a popular misconception. We should distinguish at least two types of ceiling-pendant cave deposits: stalactites formed by internal flow, and draperies formed by purely external flow. Migration of water from a central tube outward can give rise to an intermediate structure, a cylindrical drapery.—E.S.L.

8970 **Larson, Leonard H.; Poldervaart, Arie; Kirchmayer, Martin.** Geologic evolution of the Beartooth Mountains, Montana and Wyoming—Pt. 7, Structural homogeneity of gneisses in the Lonesome Mountain area: Geol. Soc. America Bull., v. 77, no. 11, p. 1277–1291, illus., geol. map, 1966.

The area is underlain by an Archean crystalline complex that is composed mainly of tonalitic-to-granitic gneisses, migmatites, and ortho-amphibolites, and also minor metasedimentary rocks, pegmatites, and orbicular granitoid rocks. The rocks are folded into upright, open folds. Attitudes of compositional and mineral foliations define a statistical fold axis for the area that plunges southerly about 30°. Small fold axes and mineral lineations are subparallel to the statistical fold axis. The geometry accurately describes the large-scale folds outlined on the map by amphibolite and migmatite lenses. The form of the folds indicates passive flowage folding of structurally homogeneous rock, during which earlier structures would have been destroyed or transposed. Similar fold geometry is found in nearby areas of the Beartooth Mountains.—R.A.L.

9347 **Laverdière, Camille.** Le vocabulaire de la géomorphologie glaciaire, [Pt.] 2: Rev. Géographie Montréal, v. 20, nos. 1–2, p. 104–107, 1966.

Definitions and authors' usages of French terms, and some English equivalents, for glacial deposits and features are discussed under the following topics: till; indicators (erratics) and debris trains; "roches moutonnées" and plucked surfaces; deposition and disintegration.—V.M.J.

9027 **Leach, S. D.; Grantham, R. G.** Salt-water study of the Miami River and its tributaries, Dade County, Florida: Florida Geol. Survey Rept. Inv. 45, 36 p., illus., 1966.

The main threat to water resources in the Miami area is salt-water intrusion into the Biscayne aquifer. Salt-water pollution may be held at its present location or moved seaward by raising fresh-water levels in the ground by increasing fresh-water heads behind control dams, or by moving controls farther downstream in canals. If salinity controls were redesigned so they could be closed when flow starts to reverse during hurricanes, they could more effectively protect the area from floods, salt-water encroachment, and better conserve fresh-water resources. If extreme conditions recur along with increased withdrawals from the fresh-water supply, salt water might move inland to the extent that it could cause reduction in capacity of the Hialeah well field to supply fresh-water needs.—*from* Authors' abstract

9109 **Leech, G. B.** The Rocky Mountain Trench, *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-14, p. 307–329, illus. [1966].

The Rocky Mountain Trench is a chain of valleys of unlike character extending along the Canadian Cordillera for about 1,600 km. The ends consist of block-fault valleys initiated in early Tertiary or latest Cretaceous. Other segments are erosional valleys along major fault zones. The length of the Trench, linearity of major segments, and its orientation would indicate a strike-slip fault, but there is evidence that the block-fault segments do not contain such faults. The problem is complicated by the fact that the Trench traverses allocthonous terranes; that in the south was emplaced by thrusting in the Paleocene. Farther north the last important eastward transport was slightly earlier. Contrast between continuity and length of the Trench compared to diversity of segments, leads to a theory of a reactivated old, deep fracture zone.—E.S.L.

9026 **Leggat, E. R.; Davis, M. E.** Analog model study of the Hueco bolson near El Paso, Texas: Texas Water Devel. Board Rept. 28, 26 p., illus., 1966.

The water needs of the El Paso district, including Ciudad Juarez, Mexico, are dependent largely on ground water, of which 75 percent is from the Hueco bolson. Although the supply is large, it is being depleted. The electrical-analog model is the most effective and economical tool with which to make a quantitative analysis of the water in the bolson. The accuracy and reliability of the model were assessed by comparing water-level changes computed by the model for the periods 1903–53 and 1903–63 with field data. On the basis of a suggested pumping program, changes in water levels in the bolson were predicted by the model. The maximum decline by 1975 would approximate 70 feet in the northern part, and by 1990, 110 feet in the same area.—*from* Authors' abstract

9457 **Leighton, Morris M.** Recollections and reflections—The Illinois Geological Survey 1905–1954: Geotimes, v. 11, no. 2, p. 13–17, illus., 1966.

The first state geological survey in Illinois was organized in 1851, with J. G. Norwood as state geologist. Headquarters were in New Harmony, Ind., for four years because Illinois lacked a state university. After 30 years without a survey one was established at the Univ. of Illinois in 1905 and a program to serve the economic and educational needs of the State was outlined. When Dr. Leighton became chief in 1923, the staff consisted of 9 full-time geologists with 15 part-time in the summer. A reorganization in 1930 divided the survey into four sections. Highlights reviewed are work on coals and discovery of oil in the Illinois basin. Dr. Leighton believes that clay mineralogy has been the most important project.—E.S.L.

9190 **LeMone, David V.** Trilobite fauna of the uppermost El Paso Group, Franklin Mountains, Texas [abs.], *in* Guidebook of Taos-Raton-Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 121, 1966.

LePichon, X. *See* Talwani, M. 9110

9155 **Lesure, F. G.; Weissenborn, A. E.** Beryllium, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 62–63, table, 1966.

Beryllium is present in trace amounts in unaltered silicic volcanic rocks in the central and northeastern parts of the State (Coats and others, 1962), and the complex assemblage of granitic and metamorphic rocks, especially in the Cascade Range, might offer a favorable environment for deposits of nonpegmatitic beryllium. The beryllium content of brine from saline lakes of eastern Washington and of surrounding salt deposits is far too low to be of commercial interest but suggests that further investigation for the source of the beryllium might be profitable. W.L.G.

9266 **Lesure, F. G.** Feldspar, mica, and other pegmatite minerals (including some nonpegmatite sources of feldspar and mica), *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 189–198, illus., table, 1966.

"Feldspar, mica, and quartz are the chief pegmatite minerals that have potential economic importance in Washington. Beryl, columbite-tantalite, and lepidolite have been found only in small and generally noncommercial amounts in a few pegmatites. Other minerals such as apatite, garnet, tourmaline, various phosphates, and uranium minerals are only of mineralogical interest. Sporadic prospecting and a little mining have been done on the pegmatite deposits. Total production, valued at a few thousand dollars, includes 700 pounds of sheet mica from Chelan County, a few tons of scrap mica from Skagit County, and a few thousand pounds of beryl from Stevens County. Resources of feldspar and scrap mica may be large, but known resources of sheet mica, beryl, columbite-tantalite, and lithium minerals are small or none." Reported occurrences of pegmatite, mica, and feldspar are given in a table.—W.L.G.

9346 **Lewis, Laurence A.** The adjustment of some hydraulic variables at discharges less than one cfs: Prof. Geographer, v. 18, no. 4, p. 230–234, illus., table, 1966:

Previous studies dealing with behavior of a stream's width, depth, and velocity with fluctuation in discharge have shown that adjustment of dependent variables with changes in discharge could be expressed by simple exponential equations. These equations were based only on studies of streams with discharges exceeding one cubic ft per second: it was assumed that intercept values for streams with discharges of less than 1 cfs could be determined by extrapolation, with adjustment of dependent variables remaining constant. It is here shown that curves fitted to data for moderate and large discharges do not remain valid for small discharges in channels of some profile shapes. In the Río Sana Muerto [Puerto Rico] channel the stream adjusts to small discharges by occupying only the right portion of the bed. At the point where the river ceases to cover the whole bed, new equations must be derived.—V.M.J.

9456 **Lewis, R. R.; Senftle, F. E.** The source of ferromagnetism in zircon: Am. Mineralogist, v. 51, nos. 9–10, p. 1467–1475, illus., table, 1966.

Magnetic susceptibility and magnetization measurements on more than 100 specimens of zircon from granitic rocks show weak ferromagnetic properties. Leaching, reduction, and oxidation experiments along with magnetization studies on some of these specimens indicate that the crystal grains are coated with one or more iron oxides and/or iron oxide hydrates and that the ferromagnetism is due to either or both Fe_3O_4 and γ-Fe_2O_3. The Fe_3O_4 or γ-Fe_2O_3 are not necessarily contamination brought in from outside the zircon crystals, but are formed by oxidation of natural impurity iron exposed at the grain surface to the atmosphere. Freshly broken surfaces exposing ionic iron impurity of the zircon to the atmosphere develop magnetization as a result of oxidation.—Authors' abstract

9387 **Lickus, Robert J.** Variation of copper–zinc ratios in the ore deposits of the Vauze Mine, Noranda district, Quebec [abs.]: Mining Eng., v. 18, no. 12, p. 52, 1966.

9131 **Liebermann, Robert C.; King, Chi-Yu; Brune, James N.; Pomeroy, Paul W.** Excitation of surface waves by the underground nuclear explosion Long Shot: Jour. Geophys. Research, v. 71, no. 18, p. 4333–4339, illus., table, 1966.

The Long Shot underground nuclear explosion, detonated at Amchitka Island in the Aleutians, generated surface waves equivalent to those of an earthquake of surface wave magnitude $M_s = 3.9$. The body wave magnitude is $M_b = 6.1$. The surface wave generation by Long Shot was significantly less than that of earthquakes of comparable body wave magnitudes. As the body waves from Long Shot also contain less long-period energy relative to the earthquakes, it is concluded that Long Shot did not efficiently excite the long-period part of the seismic wave spectrum.—D.B.V.

Lilly, J. E. *See* Frost, N. H. 8921

9021 **Lineback, Jerry A.** Deep-water sediments adjacent to the Borden Siltstone (Mississippian) delta in southern Illinois: Illinois Geol. Survey Circ. 401, 48 p., illus., table, 1966.

Rocks of early Valmeyeran age exhibit four major, laterally adjacent, noncontemporaneous, nonintergrading lithologic aspects. The Fern Glen, Burlington, and Keokuk represent a crinoidal bank that stood west of, and topographically above, a deep-water basin. The Borden Siltstone, and Warsaw and Springville Shales represent parts of a delta that invaded and restricted the deep-water basin and overrode the crinoidal bank. The Fort Payne is a tongue-shaped body of dark-colored limestone that partially filled the basin after the deltaic deposition. Ullin Limestone is a new name proposed for the light-colored bryozoan-rich limestone that overlies the Borden and Fort Payne. The Salem is a shallow-water carbonate that overlies the lower Valmeyeran sequence. [Seven cross sections are included and appendixes give four measured sections and two sets of well samples].—*from* Author's abstract

9168 **Ling, Hsin-Yi.** Notes on patagium in the radiolarian genera *Hymeniastrum* and *Dictyastrum*: Micropaleontology, v. 12, no. 4, p. 489–492, illus., 1966.

A continuous variation in degree of preservation or in development stages of patagium is found in specimens of the genera *Hymeniastrum* and *Dictyastrum* from a Northeast Pacific bottom sample. The variations are discussed and illustrated. A relationship of this variation to radiolarian ontogeny seems unlikely, although its real significance cannot be decided at this time. The taxonomic value of patagium needs critical reconsideration for some of the spumellarian Radiolaria.—Author's abstract

9211 **Lister, Judith Smith.** The crystal structure of two chlorites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1188B–1189B, 1966.

9154 **Livingston, V. E., Jr.** Bauxite, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 58–62, illus., 1966.

The known bauxite deposits of Washington are located in Cowlitz and Wahkiakum Counties in the southwestern part of the State and were formed by the laterization of basalt flows during the Pliocene. The bauxites are ferruginous and could be considered as a source of iron in conjunction with the extraction of alumina. Average analysis for Washington bauxite is about 39 percent Al_2O_3, 7 percent SiO_2, 29 percent Fe_2O_3, 4 percent TiO_2, and 21 percent loss on ignition.—W.L.G.

9160 **Livingston, V. E., Jr.** Iron, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 92–100, illus., table, 1966.

Iron ore produced in Washington has been used to make ferromagnesite, heavy concrete aggregate, ferroalloys, and mineral pigments rather than steel. It is also used as an ingredient in special portland cement, for atomic reactor shielding, and for ship ballast. A list of the most widely known iron deposits and those that have had some production are given in a table, and locations of deposits plotted on a map.—W.L.G.

Livingston, V. E., Jr. *See* Hosterman, J. W. 9264

9265 **Livingston, V. E., Jr.** Diatomite, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 185–189, illus., 1966.

Diatomite deposits occur in several localities in Washington but principal known resources are in the Squaw Creek and Quincy areas of Kittitas and Grant Counties, respectively. Both deposits are described briefly.—W.L.G.

9240 **Livingstone, John Lee.** Geology of the Brevard Zone and the Blue Ridge province in southwestern Transylvania County, North Carolina [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1189B, 1966.

9292 **Löken, Olav H.** Baffin Island refugia older than 54,000 years: Science, v. 153, no. 3742, p. 1378–1380, illus., 1966.

Two radiocarbon determinations on marine shells from the east coast of Baffin Island give ages exceeding 50,000 years. These findings indicate the existence of unglaciated areas (refugia) between fiords occupied by outlet glaciers flowing toward Baffin Bay, from the central part of the Wisconsin ice sheet, over the Foxe Basin–Hudson Bay area.—Author's abstract

9239 **Long, Austin.** Late Pleistocene and Recent chronologies of playa lakes in Arizona and New Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1189B–1190B, 1966.

9313 **Longman, I. M.** The application of rational approximations to the solution of problems in theoretical seismology: Seismol. Soc. America Bull., v. 56, no. 5, p. 1045–1065, illus., table, 1966.

The method of approximate Laplace transform inversion is applied to the problem of propagation from a quadratic pulse point source in a uniform liquid sphere. In addition, the relationship between the efficiency of the method and sharpness of the pulse is illustrated in a general way by consideration of three simple examples. In order to suggest how the technique can be extended to more difficult theoretical seismic problems, the method is applied to a simple function f(p) having branch points on the imaginary axis in the p-plane.—D.B.V.

9257 **Longshore, John David.** Chemical and mineralogical variations in the Virgin Islands batholith and its associated wall rocks [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1190B, 1966.

Loveridge, W. D. *See* McCartney, W. D. 9405

Lovering, T. G. *See* Young, E. J. 9145

9424 **Lund, Charles R.** (compiler). Data from controlled drilling program in Will and southern Cook Counties, Illinois: Illinois Geol. Survey Environmental Geology Note 10, 56 p., illus., tables, 1966.

Descriptions of character and sequence of materials, and data on relative consistency, natural water content, and grain-size distribution are given for glacial deposits tested and sampled, as a part of a controlled drilling program, at thirteen sites in Will County and one in the southern part of Cook County.—Author's abstract

9078 **Luth, W. C.; Tuttle, O. F.** The alkali feldspar solvus in the system Na_2O-K_2O-Al_2O_3-SiO_2-H_2O: Am. Mineralogist, v. 51, nos. 9-10, p. 1359-1373, illus., tables, 1966.

Preliminary experiments . . . indicate that the nature of the alkali feldspar solvus is influenced by the Na_2O+K_2O:Al_2O_3 molar ratio in the bulk composition. The solvuses obtained by the crystallization of dehydrated gels in the presence of an aqueous vapor phase at two kilobars show significant differences which are dependent on the stoichiometry of the initial bulk composition. This feature may be a consequence of differences in thermal state in the various synthetic feldspars, or it may reflect a departure from stoichiometry.—Authors' abstract

9046 **Luttrell, Gwendolyn W.** Base- and precious-metal and related ore deposits of Virginia: Virginia Div. Mineral Resources Mineral Resources Rept. 7, 167 p., illus., table, 1966.

There are various occurrences of gold, pyrite, copper, zinc, lead, arsenic, nickel, tin, tungsten and barite in veins and metamorphic rocks of the Piedmont and Blue Ridge provinces, in derived placers and Triassic shales, and in replacements in Paleozoic rocks of the Valley and Ridge province. Four hundred and ninety-six mines and prospects are briefly described, grouped primarily by mineral assemblages, and location shown on accompanying map on the basis of published, obscure, and unpublished information dating back to 1837. Early mine production lost much in tailings, some of which, with recent improvements in metallurgy, technology, and transportation, warrant further study. Stratigraphic names used in descriptions of mines and prospects are compared, in the table, with those in current use.—G.D.C.

Lynott, T. P. *See* Schirk, G. V. 9214

9049 **Machairas, G.; Blais, R.** La transformation de l'hédenbergite manganésifère en ilvaite dans les sulfures de cuivre et de zinc de la région de Noranda (Québec): Soc. Francaise Minéralogie et Cristallographie Bull., v. 89, no. 3, p. 372-376, illus., table, 1966.

Transformation of manganiferous hedenbergite to ilvaite is found in the Lake Dufault deposit of massive sulfides of copper and zinc. Corroded residues of hedenbergite crystals surrounded by ilvaite have been observed. Microprobe analyses have shown that the ratio of the Mn content in hedenbergite and ilvaite is comparable to that of Fe. The iron-bearing solutions which deposited the

magnetite appear to have furnished the balance of Fe necessary for formation of ilvaite. During this transformation the structure of hedenbergite consisting of tetrahedral chains of the Si_2O_6 type, is broken forming the Si_2O_8 groupings of ilvaite.—Authors' abstract, E.S.L.

8917 **Mackay, J. Ross; Stager, J. K.** Thick tilted beds of segregated ice, Mackenzie Delta area, N.W.T.: Biul. Peryglacjalny, no. 15, p. 39–43, illus., 1966.

Sheets of ground ice exposed along the coasts of Kendall and Garry Islands appear to be interstratified with Pleistocene marine sediments, and, where the sediments are deformed by ice-thrust, the ice sheets are also tilted or folded. Of the three most probable interpretations of the origin of these tilted ice sheets, the only one that fits all conditions is ground ice grown in a horizontal position and tilted by glacial ice-thrust.—E.S.L.

9153 **MacLaren, D. R.** Antimony, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 52–57, illus., 1966.

The total recorded antimony production from Washington has been a little more than 3,300 tons of ore. Huntting (1956) lists 275 mines and prospects where antimony minerals occur, but production has been recorded from only 9 mines. Of these only 5 are primarily producers of stibnite. Stibnite is known to occur at many localities in the State and in rocks ranging from Precambrian metamorphics to Tertiary lavas. The most promising areas in which significant amounts of stibnite might be found are the borders of mining areas in which well-fractured sedimentary or volcanic rocks are found and where mineralization took place during late Mesozoic or Tertiary times.—W.L.G.

8979 **Maderak, M. L.** Sedimentation and chemical quality of surface water in the Heart River drainage basin, North Dakota: U.S. Geol. Survey Water-Supply Paper 1823, 42 p., illus., tables, geol. map, 1966.

Streamflow of the Heart River and tributaries during 1949–58 was directly proportional to the drainage area in southwestern North Dakota. Processes that contribute sediment to the Heart River are mass wasting, advancement of valley heads, and sheet, lateral stream, and gully erosion. In general, glacial deposits, terraces, and bars of Quaternary age are sources of sand and larger sediment, and rocks of Tertiary age are sources of clay, silt, and sand. Average annual suspended-sediment discharges near Mandan were estimated at 1,300,000 tons for 1945–49 and 710,000 tons for 1950–58. During extremely low flows the water contains a large percentage of sodium and about equal percentages of bicarbonate and sulfate, and during extremely high flows a large percentage of calcium plus magnesium and bicarbonate.—*from* Author's abstract

9018 **Mahoney, Leona R.** 1965 index of publications of the Geological Survey of Canada: Canada Geol. Survey Paper 66-3, 70 p., 1966.

This index continues that of Paper 65-3, which included publications up to March 1965. In addition to map series, printed reports are: memoirs, comprehensive reports on the geology of specific areas; bulletins, detailed scientific studies on any geological or related subject; economic geology reports, comprehensive studies of economic interest on a broad regional basis; and preliminary series, designed for the prompt publication of geological information of immediate practical interest.—*from* Author's introduction

Major, Alan. *See* Ringwood, A. E. 9125

9363 **Major, Robert L.** Mineral resources and mineral industries of the southeastern Illinois region: Illinois Geol. Survey Mineral Economics Brief 14, 36 p., illus., tables, 1966.

The southeastern Illinois region includes 27 counties and is the most important minerals district in the State, having produced 308 million dollars worth of mineral products in 1964, or about 50 percent of the State's total for the year. The region

accounts for 95 percent of the crude oil and 50 percent of the coal produced in Illinois. Other minerals produced in 1964, in order of value, were crushed and broken limestone, clay products, gravel, gas, and sand. Mineral processing facilities include two secondary zinc smelters and two crude oil refineries.—*from* Author's abstract

9097 **Maldonado-Koerdell, M.** Geological and geophysical studies in the Gulf of Fonseca–Nicaraguan Depression area, Central America, *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–14, p. 220–238, illus. [1966].

Two structural masses in Central America developed through a long volcanic tectonic history and have guided, and still guide, geological and geophysical processes. They are the Nuclear Central American mountainous salient in the north, and the Costa Rica–Panama spur of the Cordillera in the south. Between these lies a lowland criss-crossed by faults of complicated origin and pattern, and characterized by abundant volcanoes, geothermal sources, and earthquakes. The Bay of Fonseca and Nicaraguan Depression hold the key that will explain many obscure points in the structure of the isthmus. Sketch maps include gravity, aeromagnetic, geologic, and tectonic.—E.S.L.

9191 **Mallon, Kenneth M.** Precambrian geology of the northern part of the Los Pinos Mountains, New Mexico [abs.], *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 121, 1966.

Marshall, Lauriston C. *See* Berkner, Lloyd V. 9447

Marshall, Neil F. *See* Rosfelder, André M. 8914

Martin, Michael K. *See* Fox, William T. 9117

8987 **Martinez, Anibal R.** Estimation of petroleum resources: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 9, p. 2001–2008, illus., table, 1966.

Martinez discusses and evaluates Weeks' (1965) paper on offshore oil resources and Hubbert's (1962) report on United States oil resources and (1965) reply to a discussion by Ryan (1965). Petroleum resources are the sum total of four different volumes: production, proved reserves, supplementary reserves, and undiscovered reserves. In analyzing oil resources, one should consider that the principal use of the estimates is for long-range planning. The estimates cannot be used as exact parameters, but as guides which provide sound bases to organizations for policy studies and information. Competent researchers should use the Weeks' (1965) method of estimating the magnitude of oil resources and the Hubbert (1965) method of estimating the duration of these resources (modified as necessary by conditioned prediction).—M.W.G.

9444 **Masuda, Akimasa.** Effect of co-ordination number on lanthanide abundance variation: Nature, v. 212, no. 5063, p. 757–758, illus., table, 1966.

When lanthanide abundances in terrestrial and meteoritic material are compared with those in "average chondrite" and the ratios plotted against atomic number or ionic radius, simple curves are obtained; the patterns may be classified, by the presence or absence of a break in the smooth curve, as inflexional or monotonic. The interpretation of the monotonic lanthanide pattern in terms of the replacement of ferromagnetic cations by lanthanides is considered quite reasonable. However, the inflexion of the other pattern is probably caused by the structure of the anion silicate network, rather than by the presence of Ca cations. This interpretation also explains the more or less distinct discontinuity between the monotonic and inflexional patterns.—D.B.V.

9477 **Matlock, W. G.; Fogel, M. M.; Busch, C. D.** Utilization of water resources in a coastal groundwater basin—Pt. 2, Groundwater supply and incipient saltwater

intrusion: Jour. Soil and Water Conserv., v. 21, no. 5, p. 166–169, illus., tables, 1966.

Ground water is the sole source of water in the coastal plain of Hermosillo, Sonora, Mexico. The supply is very limited, and pumping for irrigation has lowered drastically the level in the ground-water basin allowing salt water to intrude. The aquifer in the basin is alluvial, with blue clay at depths of 600 to 1,200 feet. Zones of higher permeability exist along three major river channels which contribute to recharge, but the evaporation rate is more than 12 times the rainfall. A ground-water flow gradient has been established from the sea to the pumping area, and the salt content of one well has more than doubled in a year.—E.S.L.

Matthews, B. *See* Maycock, P. F. 8910

9223 **Mauger, Richard L.** Primary igneous petrologic factors in the interpretation of porphyry [abs.]: Mining Eng., v. 19, no. 1, p. 63, 1967.

9256 **Mauger, Richard Leroy.** A petrographic and geochemical study of Silver Bell and Pima mining districts, Pima County, Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1190B, 1966.

9200 **Maurer, Robert E.** The coal fields of eastern Sevier County, Utah, *in* Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, p. 111–119, illus., geol. map, 1966.

The coal-bearing Cretaceous sandstone cliffs of the Wasatch Plateau front and Coal Cliffs southeast of Emery lie in a homoclinal area. Westward near the mouth of Salina Canyon the dips increase. Coal of the Castle Valley field occurs in the Ferron Sandstone Member of the Mancos Formation, and that of the Wasatch Plateau field and Salina Canyon district in the Blackhawk Formation. Several north trending normal faults across Salina Canyon produced graben valleys such as one east of Musinia Peak, making coal beds more accessible to mining in this district. Of 18 distinct beds exposed by stream cutting, only three seem to have potential value. With no significant production from Castle Valley, total for the other two fields from 1942 to 1964 was over 1,058,000 short tons, 75 percent from the Wasatch Plateau field.—G.D.C.

9136 **Maxey, George B.; Mifflin, Martin D.** Occurrence and movement of ground water in carbonate rocks of Nevada, *in* Limestone hydrology—A symposium with discussion: Natl. Speleol. Soc. Bull., v. 28, no. 3, p. 141–157, illus., tables, 1966.

Carbonate rocks constitute important aquifers in large parts of eastern and southern Nevada. Ground-water flow systems can be divided into: (1) local, with small drainage area and springs having large fluctuations, and (2) regional, with large drainage areas and springs having steady discharge. Of the 62 carbonate-rock springs included, 24 are recognized as being in local systems and 17 in regional systems. The springs are listed by counties and the analyses of their waters tabulated. Conventional speleologic and geologic investigations alone are not powerful enough tools to characterize most flow systems in Nevada, and additional hydrologic approaches employed include water-budget studies, water-potential studies, and water-chemistry studies. Integration of geologic and hydrologic methods permits an approximate portrayal of many systems.—E.S.L.

8910 **Maycock, P. F.; Matthews, B.** An *arctic forest* in the tundra of northern Ungava, Quebec [with French and Russian abs.]: Arctic, v. 19, no. 2, p. 114–144, illus., tables, 1966.

An extensive willow thicket community containing *Salix* of tree size was discovered in a river valley thirty-two miles southeast of Deception Bay (61°31′ N., 74°5′ W.). This disjunct community seemed unusual enough to merit investigation. Ecological studies were conducted to determine compositional and environmental features. The development and persistence of the community is discussed in relation to the

existing climate and glacial history of the region as it is understood at present.—Authors' abstract

9405 **McCartney, W. D.; Poole, W. H.; Wanless, R. K.; Williams, H.; Loveridge, W. D.** Rb/Sr age and geological setting of the Holyrood granite, southeast Newfoundland: Canadian Jour. Earth Sci., v. 3, no. 7, p. 947–957, illus., tables, 1966.

The Precambrian Holyrood granite of southeastern Newfoundland lies on the easternmost exposed flank of the Appalachian mobile belt. Although formerly thought to be Grenville in age, this granite yields a Rb/Sr isochron age of 574±11 m.y. Tectonic and sedimentary events that followed the granite emplacement, and that preceded deposition of noncomformably overlying fossiliferous Lower Cambrian strata, are believed to have taken at least 15 m.y. Therefore, a tentative maximum age of 560±11 m.y. is proposed for the base of the Cambrian in this region.—Authors' abstract

9124 **McConnell, Harold.** A statistical analysis of spatial variability of mean topographic slope of stream-dissected glacial materials: Assoc. Am. Geographers Annals, v. 56, no. 4, p. 712–728, illus., 1966.

It is probable that spatial variability of topographic slope is best explained by some measure of the vertical topographic dimension in areas where insufficient time has elapsed since deposition of materials for slopes to attain time independence. A statistical analysis of some spatial relationships of *mean* topographic slope beyond that with local relief was conducted on erosional terrain in the glaciated Upper Mississippi Valley. Although all variables are statistically significant, the results indicate that factors other than relief, including nature of long stream profile, position, orientation, degree of dissection, and parent materials, have less relevance in explaining place-to-place variation of topographic slope.—Author's abstract

9119 **McCrone, Alistair W.** The Hudson River estuary—Hydrology, sediments, and pollution: Geog. Rev., v. 56, no. 2, p. 175–189, illus., 1966.

The inland physical limit of the Hudson River estuary is located approximately between Poughkeepsie and Newburgh, N. Y. The biologic limit is near Bear Mountain. River-bottom sediments in the upper reaches of the estuary channel are typically clayey silts, many of which are contaminated by fragments of cinders, coal, metal, brick, and sewage. In 1964 the principal man-made radioactive isotopes detected in the river muds bore no obvious correlation with cation exchange capacity, gross sedimentary mineralogy, or water salinity. Finer sediments, especially those with an organic content of more than 11 percent, seemed to concentrate above-average amounts of radioactive pollutants, but in quantities still so small as to be trivial with respect to the public health.—Author's abstract

9169 **McCrone, Alistair W.; Schafer, Charles.** Geochemical and sedimentary environments of foraminifera in the Hudson River estuary, New York: Micropaleontology, v. 12, no. 4, p. 505–509, illus., tables, 1966.

Foraminifera survive in the Hudson River estuary only in salinities greater than 5 parts per thousand. *Miliammina* and *Ammomarginula* were the only genera able to tolerate salinities near the 5 0/00 minimum. At low salinities *Ammonia* and *Trochammina* were observed in the chitinous state. The foraminifera were associated mainly with clayey silt muds which had pH's near 7, positive Eh's and cation exchange capacities in the order of 30 to 40 milliequivalents per hundred grams. The sediments containing the foraminifera were highly unsaturated with the common metallic cations that are usually important in nutrition.—Authors' abstract

McCullough, Richard A. *See* Whitcomb, Harold A. 8978

9309 **McCutcheon, Thomas E.** Claiborne County clay tests, *in* Claiborne County geology and mineral resources: Mississippi Geol. Econ. and Topog. Survey Bull. 107, p. 125–174, illus., tables, 1966.

Three types of clays from Claiborne County, Miss., were tested for properties—bond clays from the Catahoula, loess clays, and alluvial deposits. Bond clays are suitable for plastic applications in refractories, loess clays are used in brick and tile manufacturing and have possible use as a filler, and the alluvium is best suited for lightweight aggregate. Screen analyses and pyrophysical properties are tabulated in detail.—E.S.L.

8984 **McGrain, Preston.** Memorial to Daniel J. Jones (1889–1965): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1526, portrait, 1966.

9067 **McLearn, F. H.** *Anagymnotoceras*, a new Middle Triassic (Anisian) ammonoid genus from northeastern British Columbia: Canada Geol. Survey Paper 66-56, 5 p., illus., 1966.

A new ammonoid genus, *Anagymnotoceras* (Beyrichitidae) is proposed. The type species is *Anagymnotoceras varium* (McLearn) from the Toad Formation of northeastern British Columbia, and of Anisian (Middle Triassic) age.—Author's abstract

9130 **McLellan, Alister G.** A thermodynamical theory of systems under nonhydrostatic stresses: Jour. Geophys. Research, v. 71, no. 18, p. 4341–4347, 1966.

A thermodynamic theory based on the treatment of an inhomogeneous system, assumed to be composed of homogeneous parts or phases, is presented. It is shown that consideration must be given to possible discontinuities in the displacements of points in the mediums at interfaces. These discontinuities may provide space for the products of chemical or other types of interchange of components at interfaces. The theory shows the inadequacy of Kumazawa's theory and the correctness of Kamb's, which is a special case of the present theory.—D.B.V.

9054 **McMaster, Robert L.; Garrison, Louis E.** Mineralogy and origin of southern New England shelf sediments: Jour. Sed. Petrology, v. 36, no. 4, p. 1131–1142, illus., 1966.

Mineral compositional studies of continental shelf sediments of the northeast coast of the United States between Hudson and Veatch Canyons are described. The sand fractions of grab samples are classified according to mineral associations and assigned to petrological provinces, believed to have resulted from changes in composition of adjacent coastal rocks. Relative ages of heavy mineral associations are determined on the basis of depositional sequence.—E.D.M.

9205 **Melson, William G.; VanAndel, Tjeerd H.** Metamorphism in the Mid-Atlantic Ridge, 22°N latitude: Marine Geology, v. 4, no. 3, p. 165–186, illus., tables, 1966.

Greenstones dredged at two stations on the eastern slope of the median valley consist mainly of albite, actinolite, chlorite, and epidote, a typical greenschist assemblage reflecting increasing metamorphic grade with depth. Bulk chemical analyses of six greenstones give spilitic compositions characterized by high soda and low potash. Relics of calcic plagioclase, pseudomorphs of olivine phenocrysts, and other textural features indicate derivation from abyssal basalts. The alkali contents are probably a result of metasomatism during metamorphism, and do not indicate a primary spilitic magma, or reaction between magma and sea water. The significance of the greenstones in relation to the tectonics and structure of the Ridge are discussed. Depth of burial is estimated at a minimum value of 2 km beneath the ocean floor. Therefore, minimum vertical displacement along faults should be a few kilometers to expose greenschist facies rocks.—E.S.L.

9070 **Menard, H. W.; Smith, Stuart M.** Hypsometry of ocean basin provinces: Jour. Geophys. Research, v. 71, no. 18, p. 4305–4325, illus., tables, 1966.

The frequency distribution of ocean basin depths has been determined using the latest American and Russian charts, with computer data processing. Data are compiled for individual ocean basins and marginal seas, and for nine different physiographic provinces. Considering both land and sea, the commonest levels are about sea level and about 5 km, the general depth of ocean floor. The distribution

of depths in the ocean basin province is singly peaked and symmetrical; that in the rise and ridge province is similar, but with mean depth about 1 km less. The development of rises and ridges may have caused substantial fluctuations in sea level during geologic time.—D.B.V.

Mencher, Ely. *See* Schopf, James M. 9427

9339 **Mero, J. L.** Exploration for oceanic mineral deposits: Inst. Mining and Metallurgy Trans., Sec. B, v. 75, Bull. 717, p. B199–B207, illus., tables, 1966.

Some mineral deposits in the sea, such as placers and subsea-floor rocks, are similar to those on shore and can be explored by such conventional techniques as seismic probe coupled with core drilling, and sampled with clamshell buckets. Sea-water bodies having abnormally high concentrations of metallic elements, in some cases considered as "ore bodies", can be explored by sensitive assays. Most attractive from an economic viewpoint are surficial sea-floor deposits of phosphorite and manganese nodules which can be discovered by television cameras, and sampled with drag buckets. Deep-sea clays and oozes can be sampled by conventional deep-sea coring. The minerals of interest in the several types of deposits are listed.—G.D.C.

9372 **Merritt, Paul C.** Potash, *in* Phosphate and potash—Minerals to feed the world: Mining Eng., v. 18, no. 10, p. 100–114, illus., table, 1966.

Prediction of a rapidly increasing market for fertilizer minerals has caused a truly astounding expansion in the potash industry. The present prodigious growth centers largely—but not entirely—in Saskatchewan where potash was first discovered in 1943. The Canadian potash beds are now known to contain 15–20 billion tons—the greatest reserves in the world. The occurrence, mining and beneficiation of potash are very similar through the North American continent. A brief history of the potash industry is followed by accounts of the operations and activities of individual potash-producing companies in the United States and Canada.—F.C.C.

Michelson, Ronald W. *See* Hussey, Keith M. 8920

Mifflin, Martin D. *See* Maxey, George B. 9136

9460 **Mikkelson, D. H.** The origin and age of the Mississippian "Chat" in north-central Oklahoma: Shale Shaker, v. 17, no. 2, p. 23–33, illus., 1966.

"Chat" is so well established in usage that it will continue to exist as a recognizable unit name among petroleum geologists, even though it is neither a proper time nor rock unit. It is a highly weathered product of erosion of Mississippian limestone, extremely variable in lithology, and with exact age uncertain. The "Chat" is usually found where the top of the Mississippian limestone would be expected, within the Mississippian limestone section, or in the Mississippian–Pennsylvanian unconformity zone, where it should not be. Diagrammatic cross sections illustrate its origin. It is an excellent reservoir rock, and is best developed in association with structural closure or faulting. A structure contour map on the "Chat" surface of north-central Oklahoma is included.—E.S.L.

9370 **Miles, Roger S.** *Protitanichthys* and some other coccosteomorph arthrodires from the Devonian of North America: Kgl. Svenska Vetenskapsakad. Handlingar, 4th ser., v. 10, no. 3, 49 p., illus., 1966.

Type specimen of *Protitanichthys fossatus* Eastman, a partial skull-roof, from the Delaware Limestone of Ohio, is redescribed, and a series of specimens of *P. rockportensis* from the Traverse Group of Michigan, and plates of similar age and uncertain generic identity from Ohio and New York are described. The species *P. fossatus and P. rockportensis* are very close to each other and may be conspecific. The genus is referred to Family Coccosteidae. The type specimen of *Clarkeosteus halmodeus* (Clarke) from the Marcellus Shale of New York is redescribed. *C.* Obruchev is provisionally referred to the Coccosteidae and is distinct from other described forms. The incomplete skull-roof of a coccosteomorph from the Silica Shale of Ohio is described; no attempt is made to name it.—*from* Author's summary

Miller, Raymond W. *See* Mitchell, John E. 9398

9087 **Milliman, John D.** Submarine lithification of carbonate sediments: Science, v. 153, no. 3739, p. 994–997, illus., tables, 1966.

Recrystallized planktonic limestones from two guyots in the North Atlantic are in oxygen-isotopic equilibrium with their present ambient waters, suggesting submarine lithification and recrystallization. The early stages of submarine lithification of carbonates may involve precipitation of, and replacement by, magnesium-rich calcite; with time this may invert to magnesium-poor calcite. This type of lithification probably requires very low rates of sediment accumulation.—Author's abstract

9398 **Mitchell, John E.; West, Neil E.; Miller, Raymond W.** Soil physical properties in relation to plant community patterns in the shadscale zone of northwestern Utah: Ecology, v. 47, no. 4, p. 627–630, illus., tables, 1966.

Physical properties of loam soils associated with monospecific communities of shadscale (*Eurotia lanata*) and winterfat (*Atriplex confertifolia*) and the abrupt ecotone between them were studied in Curlew Valley, Utah, to determine soil influence on vegetation pattern. The area is directly south of a major relic shoreline of Pleistocene Lake Bonneville, and was in a zone of wave action while the lake was at the Stansbury level. Morphology of the soil profile, petrographic and X-ray diffraction analyses of the very fine sands and clays, respectively, textural analysis, bulk density and soil compressibility tests, revealed no differences that would obviously influence vegetation; nor does the vegetation seem to induce soil changes. Factors which first determined vegetation differentiation, such as soil salinity from evaporation of Lake Bonneville, may now be absent.—V.M.J.

9063 **Mitchell, Richard S.** Virginia metamict minerals—Perrierite and chevkinite: Am. Mineralogist, v. 51, nos. 9–10, p. 1394–1405, tables, 1966.

Perrierite occurs at several places in Virginia, especially in Amherst, Bedford, and Nelson Counties. Chevkinite is found only at a previously unknown locality in Nelson County. All chevkinite reported earlier from Amherst, Bedford, and Nelson Counties is actually perrierite. Indexed X-ray powder data are given, which serve to distinguish between these very similar minerals. Approximate unit cell constants for perrierite are $a = 13.61$, $b = 5.68$, $c = 11.73$ A, $\beta = 113.5°$; for chevkinite, $a = 13.60$, $b = 5.82$, $c = 11.22$ A, $\beta = 100.75°$. Semiquantitative spectrographic data show no appreciable chemical differences between perrierite and chevkinite. Both minerals contain thorium. Most of the Virginia specimens are only slightly metamict. . . .—Author's abstract

9461 **Mitterer, Richard M.** Amino acid and protein geochemistry in mollusk shells: Florida State Univ. Sedimentol. Research Lab. Contr. 14, 151 p., illus., tables, 1966.

The amino acid content of fossil *Mercenaria and Oliva* shells, and of the shell organic matrix of their modern counterparts was studied. Analysis of modern shells indicate little variability in the amino acid composition of the organic matrix due to environment. Insoluble protein, a major component of the organic matrix of modern shells, is present in low amounts in the fossil shells and is only a negligible percentage of the total amino acid content of Miocene specimens. All amino acids were present in lower amounts with increasing ages of fossil *Mercenaria* shells. Certain ratios increase consistently with increasing ages which could provide an age-dating method. Shells from an interval above the Caloosahatchee and below the Fort Thompson, thought to be Pleistocene, had an amino acid composition closer to Pliocene and Miocene shells.—*from* Author's abstract

9262 **Moen, W. S.** Barite, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 168–175, illus., table, 1966.

"Of the 35 reported occurrences of barite in the State of Washington, 26 are in Stevens County, 4 in Pend Oreille County, 3 in Okanogan County, and 1 each in Ferry and Mason Counties. Only the deposits in Stevens and Pend Oreille Counties

have produced barite [hydrothermal veins and replacements in argillaceous and calcareous sedimentary rocks]. Barite deposits in other parts of the State occur mainly as gangue in metalliferous and nonmetalliferous veins. As such, they have not been of commercial value; however, it is possible that some barite might be recovered as a byproduct in the milling of the ores." A table is included listing pertinent information about the barite deposits of Stevens and Pend Oreille Counties.—W.L.G.

Moen, W. S. *See* Zimmerman, Tom. 9275

9277 **Moen, W. S.** Stone, including limestone and dolomite, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 265–273, illus., 1966.

Large resources of basalt and andesite, granite, sandstone, limestone and marble, and quartzite are present in Washington. Much of this rock is suitable for crushed and broken stone and building stone and can supply many of the demands of the State's stone industry. Deposits are described and discussed briefly, and quarry locations shown on a map.—W.L.G.

Moody, R. A. *See* Ginsburg, R. N. 9038

Moore, Donald B. *See* Joiner, Thomas J. 9321

9141 **Moore, George W.** (editor). Limestone hydrology—A symposium with discussion: Natl. Speleol. Soc. Bull., v. 28, no. 3, 166 p., illus., tables, 1966.

The six papers comprising the symposium, held at Berkeley, Calif., in 1965, cover solution problems, an electric analog study, solution tubes on bedding planes, and two areal studies in Nevada and Kentucky.—E.S.L.

9055 **Moore, Paul B.** Catoptrite and yeatmanite—Stuffed pyrochroite structures?: Am. Mineralogist, v. 51, nos. 9–10, p. 1494–1500, illus., tables, 1966.

Catoptrite and yeatmanite are two peculiar silicoantimonates of manganese which can be described by a general formula. The catoptrite structure cell contains two such molecules, with a 5.65±.01, b 22.92±.06, c 9.06±.01A, β 101°30′±15′. The triclinic cell of yeatmanite is easily related to catoptrite. Catoptrite has a remarkable substructure easily satisfied by an equation describing about 77 percent of the total structure cell scattering matter, distributed in unperturbed pyrochroite-like sheets.—*from* Author's abstract

Moore, R. D. *See* Block, Barry. 9128

9376 **Moore, Richard T.; Peirce, H. Wesley.** Mineral exploration in the Basin–Range Province, Arizona [abs.]: Mining Eng., v. 18, no. 12, p. 46, 1966.

Moore, William J. *See* Roberts, Ralph J. 9378

9255 **Moores, Eugene Albert.** Regional drainage basin morphometry [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1191B, 1966.

Moorhouse, W. W. *See* Boutcher, S. M. A. 9297

Morris, H. T. *See* Roberts, Ralph J. 9045

9134 **Morrison, R. G. K.** Seismic energy available from rockbursts and underground explosions—Discussion [of paper by W. I. Duvall and D. E. Stephenson, 1965]: Soc. Mining Engineers Trans., v. 238 [-235], no. 3, p. 275–276, 1966.

The writer wishes to add that his figures quoted in the paper (ibid., v. 232, no. 3, p. 235–240, 1965) for some of the heaviest rockbursts in Kolar gold field were derived from only a casual comparison of surface and underground effects, and have no scientific validity. The cause of rockbursts lies with the mechanism initiating the primary failure. It would seem that with present facilities we should be able

to establish whether we are dealing with gravitational forces only or with tectonic as well.--E.S.L.

9028 **Mountjoy, Eric W.** Time of thrusting in Idaho–Wyoming thrust belt—Discussion [of paper by F. C. Armstrong and S. S. Oriel, 1965]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2612–2614, 1966.

Evidence presented by Armstrong and Oriel (ibid., v. 49, p. 1847–1866, 1965) for dating the Absaroka and Paris thrusts is not convincing, and perhaps they cannot be dated exactly. The age of the Prospect thrust is not doubted. The Evanston Formation, used in dating the Absaroka thrust as latest Cretaceous, has not been found directly overlying the fault; therefore, the Absaroka might be as young as early Eocene. Conglomerates used in dating the Paris thrust as latest Jurassic and earliest Cretaceous could have been derived from other source areas now beneath the Meade or Paris thrust sheet instead of from the Paris sheet. The sequence of thrusting from west to east cannot be positively demonstrated. Interestingly, the most accurate dating of thrusting in both the Alberta and Idaho–Wyoming thrust belts is approximately the same—Eocene.—M.W.G.

Mourant, W. A. *See* Dinwiddie, G. A. 9458

9430 **Mouritsen, S. A.** On fundamental geology and physical origins: Geol. Rundschau, v. 55, no. 3, p. 856–878, illus., 1966.

This paper presents a series of thoughts on such fundamental and still mysterious problems as the origin of mass, the Universe, the solar system, continents and their migration, the forces operating in gravitation, the hydrostatic pressures on and within continents, changes in climate, and the historical connotations of these problems. Part 1 is concerned with concepts of time, velocity, mass, and space. A hypothesis of the formation of the planets is proposed, based on the atomic fusion of a fundamental primary body, called the Ring Hypothesis of Planetary Development. Part 2 discusses problems of global geology resulting from such origin.—D.B.V.

8992 **Moyd, Louis.** Michipicoten scheelite deposit near Michipicoten Harbor, Ontario [abs.]: Am. Mineralogist, v. 51, nos. 9–10, p. 1562–1563, 1966.

8930 **Müller, F.; Barr, W.** Postglacial isostatic movement in northeastern Devon Island, Canadian Arctic Archipelago [with French and Russian abs.]: Arctic, v. 19, no. 3, p. 263–269, illus., table, 1966.

Raised marine features of the lowlands in the vicinity of Cape Sparbo were investigated. The C–14 dates of marine shells indicate that the area was clear of ice as early as 15,500 B.P. and that the most rapid isostatic uplift (approx. 6.5 m per century) took place between 9,000 and 8,000 years ago; the total isostatic rebound having been about 110 m. The two oldest dates (15,000 and 13,000 B.P.), if correct, give a rare indication of the slow onset of the isostatic uplift.—Authors' abstract

9441 **Mundorff, James C.; Waddell, Kidd M.** Fluvial sediment and chemical quality of water in the Little Blue River basin, Nebraska and Kansas: U.S. Geol. Survey Water-Supply Paper 1819-H, p. H1–H45, illus., tables, 1966.

Uppermost bedrock in the Little Blue River basin is Permian limestone and shale, and Cretaceous sandstone, shale, and limestone. Bedrock is exposed in many places in the lower one-third of the basin, but elsewhere is buried beneath a thin to thick mantle of mostly Quaternary sediments. Fluvial deposits are an important source of ground water for the upper two-thirds of the basin; loess is the most widespread surficial deposit. The river has the same suspended-sediment characteristics as nearly all unregulated streams in the Great Plains—a wide range in concentrations, low concentrations during low-flow periods, and high during almost all periods of significant overland runoff. Nearly all suspended sediment is silt and clay; streambed material is mainly medium sand to gravel. Suspended silt and clay generally are 90 percent or more of the total sediment discharge.—*from* Authors' abstract

Munson, Elaine L. *See* Young, Edward J. 9074

Munson, Elaine L. *See* Young, Edward J. 9076

9421 **Murray, Raymond C.** The geochemical cycle of gypsum and anhydrite [abs.]: Mining Eng., v. 18, no. 12, p. 45, 1966.

Myers, W. Bradley. *See* Hamilton, Warren. 9098

9317 **Nabighian, Misac N.** The application of finite forward differences in the resistivity computations over a layered earth: Geophysics, v. 31, no. 5, p. 971–980, illus., tables, 1966.

The paper describes a new method of computing the infinite series which arise in the calculation of standard graphs in the resistivity method. It is shown that, by using finite forward differences of higher orders and repeated summations by parts, the convergence of the potential and resistivity series can be improved appreciably. The procedure allows calculations with any degree of accuracy and with a substantial savings in computational labor. A correct estimate of the truncation errors involved may easily be determined.—Author's abstract

8985 **Nagel, Fritz G.** Memorial to Stanley Battershill White (1899–1965): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1526–1527, portrait, 1966.

9319 **Nakamura, Yosio.** Multi-reflected head waves in a single-layered medium: Geophysics, v. 31, no. 5, p. 927–939, illus., table, 1966.

The propagation of surface-reflected head waves has been studied experimentally using two-dimensional single-layer models. In addition to the contributions from reflected refractions and refracted reflections, those from refraction-reflection intermixtures are found to be significant, resulting in slight reinforcement of the surface-reflected head waves with increasing distance. The phase relations of the arrivals are examined by computing the Fourier transforms of the observed waveforms. Relative to the principal head-wave arrival, the surface-reflected head waves show an anomalous phase shift, probably due to the finite thickness of the model materials.—D.B.V.

9472 **Nauss, A. W.** On the distribution of ore deposits within the Canadian Shield—A discussion [of paper by F. A. Campbell and H. A. K. Charlesworth, 1965]: Geol. Assoc. Canada Proc., v. 17, p. 83–84, 1966.

In agreement with the contents of Campbell and Charlesworth's paper (ibid., v. 16, p. 31–49, 1965), Nauss enlarges on several points of tectonics. The thickness of sediments in an oceanic or ensimatic geosyncline depends not only on ocean depth, but also on specific gravity of the sediments and material into which they sink, phase changes in the rocks below the sediments, and rate of erosion on adjacent blocks. Specific gravity of the sediments increases with depth of burial and can exceed 2.7 on occasion; that of the complex material displaced cannot be easily predicted. Only the lighter materials are displaced by a sinking basin. Phase changes converting minerals into high pressure forms cause the rock to have less vertical space, which adds to the subsidence in the overlying rocks. Greater isostatic imbalance results when an adjacent area is kept light by erosion.—G.D.C.

9084 **Neal, James T.** Polygonal sandstone features in boundary Butte anticline area, San Juan County, Utah—Discussion [of paper by J. Q. Tomkins, 1965]: Geol. Soc. America Bull., v. 77, no. 11, p. 1327–1329, illus., 1966.

Orthogonal mud cracks are usually formed on playas. Hexagons and pentagons are atypical in spite of published photographs which imply that they are common [see Tomkins, ibid., v. 76, p. 1075–1080, 1965].—J.P.A.

Nelson, C. A. *See* Cloud, Preston E., Jr. 9396

Nelson, Jack L. *See* Gross, M. Grant. 9369

8906 **Neuman, Robert B.; Rankin, Douglas W.** Bedrock geology of the Shin Pond region, *in* Guidebook for field trips in the Mount Katahdin region, Maine—New England Intercollegiate Geol. Conf., 58th Ann. Mtg. 1966: [Augusta, Maine, Maine Geol. Survey] p. 8–17, illus., 1966.

This region contains one of the largest masses of felsitic volcanic rocks in the United States; facies change abruptly within short distances and exposures are inaccessible. A large anticlinorium extends northeastward across the southern half of Shin Pond quadrangle, with complementary synclines to the northwest and southeast. Lower Cambrian(?) and Ordovician rocks are exposed in the core, Silurian and Devonian sequences including volcanic rocks on the northwest flank, and Silurian assemblages without volcanic rocks on the southeast. Ages have been determined by brachiopods. Most of the rocks have been deformed and regionally metamorphosed to the chlorite grade. The Acadian orogeny was the last to affect the area, its features contrasting on opposite sides of the anticlinorium. Younger than this is the Devonian quartz monzonite of Mount Katahdin.—G.D.C.

8941 **Neuman, Robert B.** Road logs—The anticlinorium core, and the Silurian and Devonian rocks on its northwest flank; the southeast flank of the anticlinorium, *in* Guidebook for field trips in the Mount Katahdin region, Maine—New England Intercollegiate Geol. Conf., 58th Ann. Mtg. 1966: [Augusta, Maine, Maine Geol. Survey] p. 18–27, illus , 1966.

These road logs include measured sections and sketch maps showing exposures with strike and dip indicated and fossil localities. —G.D.C.

Neuman, Robert W. *See* Hill, Walter S., Jr. 9328

8935 **New England Intercoll. Geol. Conf.** Guidebook for field trips in the Mount Katahdin region, Maine—58th annual meeting, 1966: [Augusta, Maine, Maine Geol. Survey] 61 p., illus., 1966.

This guidebook to the Mount Katahdin region, an area of recent geological study, contains reports on bedrock geology, the anticlinorium core and flanks, Devonian volcanic and sedimentary rocks, geology of the Ripogenus Dam area, stratigraphy and structure of the Chamberlain Lake region, and Pleistocene geology, by individually cited authors. Sketch maps and line drawings illustrate the various features.—G.D.C.

9181 **New Mexico Geological Society; Northrop, Stuart A.; Read, Charles B.** (editors). Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., Oct. 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, 128 p., illus., tables, 1966.

The guidebook includes 12 papers, 9 of which are cited individually, and road logs for three field trips. Abstracts of technical papers presented at the 20th annual meeting are included also.—E.S.L.

Niazi, M. *See* Anderson, Don L. 9326

Nichols, Haven. *See* Perry, Richard B. 9118

9426 **Nickelsen, Richard P.** Fossil distortion and penetrative rock deformation in the Appalachian Plateau, Pennsylvania: Jour. Geology, v. 74, no. 6, p. 924–931, illus., 1966.

In Pennsylvanian shales of the Philipsburg quadrangle, the fossil *Lingula carbonaria* shows minute crinkles, microjoints, and changed width/length ratios resulting from deformation. Crinkles parallel the northeast-trending axes of Appalachian folds, and microjoints are perpencidular thereto, yet shale enclosing the fossils looks undeformed except for a broad regional jointing. Extension of lingulas in the crinkle direction is four percent; their shortening perpendicular thereto is seven to ten percent. Deformation shown by the fossils was accomodated in the shale matrix by grain movement and loss of interstitial water. This soft-state process, termed lateral compaction, occurred in the earliest stage of lateral deformation of the

Appalachians. Evidence for lateral compaction is well preserved here because the rocks have not been disturbed by later folding or flow.—B.F.L.

9089 **Nolan, Thomas B.** Memorial to Thomas Monteith Broderick (1889–1965): Geol. Soc. America Bull., v. 77, no. 11, p. P211–P214, portrait, 1966.

Nordeng, S. G. *See* Ruotsala, A. P. 8991

9068 **Norford, B. S.** Ordovician stratigraphic section at Daly River, northeast Ellesmere Island, District of Franklin: Canada Geol. Survey Paper 66–55, 12 p., illus., 1966.

A stratigraphic section of Ordovician rocks from northeast Ellesmere Island is described. Exposures span parts of two unnamed map units that together may correspond to the Cornwallis Formation and part of the Eleanor Formation of Cornwallis Island. The lower unit is a well-bedded sequence of limestones and dolomites. Deposition in shallow water and an intertidal environment is indicated by mud cracks, intraformational conglomerates, and truncated lamination. The upper unit consists of resistant, thickly bedded limestones. Three faunal assemblages of Cardoc age are present. The lowest is dated as probably Wilderness, the second probably Wilderness or Maysville, and the third as probably Eden or Maysville.—B.S.H.

9178 **Northrop, Stuart A.** Check lists of minerals for mining districts of Colfax, northern Taos, and Union Counties, New Mexico, *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 99–102, illus., 1966.

Most of these records of mineral occurrences are taken from the writer's "Minerals of New Mexico", 1959. An index map of mining districts is included, and the minerals are listed by districts within counties.—E.S.L.

9179 **Northrop, Stuart A.** Meteorites of Colfax, Union, and Taos Counties, New Mexico, *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 103, 1966.

The list contains 10 meteorite falls from Colfax County, 4 from Union County and 1 from Taos County; 12 of these are aerolites.—E.S.L.

9180 **Northrop, Stuart A.** Check lists of minerals for mining districts of Costilla, Huerfano, and Las Animas Counties, Colorado, *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 104–105, 1966.

The minerals of Costilla, Huerfano, and Las Animas Counties are listed by mining districts under the counties.—E.S.L.

Northrop, Stuart A. *See* New Mexico Geological Society. 9181

Nuzman, Carl E. *See* Winslow, John D. 9332

8938 **Oakes, Millis H.** North Cut Bank field and the Moulton sandstone, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 191–201, illus., 1966.

Recent completions in the Moulton sandstone have led to extensions of known fields. The history of development and production of nine of these fields on the Sweetgrass arch is reviewed, and the Mississippian–Cretaceous stratigraphy is outlined. The Cut Bank, Lander, and Moulton Members of the Kootenai are discussed in detail in order to clear up correlation in the older area. Two cross sections and an isopach map are included.—E.S.L.

9478 **Oakeshott, Gordon B.** San Francisco Bay area—Its geologic setting: Geotimes, v. 11, no. 3, p. 11–19, illus., 1966.

San Francisco is built on the Franciscan Formation, between the San Andreas and Hayward faults. The bay is a late Pliocene structural depression which separates the northern and southern Coast Ranges. Two rock units constitute the basement for the Bay area, Cretaceous granitic rocks with Sur Series inclusions, and the Franciscan. The latter is a heterogeneous group of marine sedimentary and volcanic rocks, 30,000 feet or more in thickness, intricately intruded by serpentine; it appears to be of Late Jurassic to Middle Cretaceous age. Marine Upper Cretaceous and Paleocene–Eocene shelf facies rocks crop out in folded and faulted remnants on both sides of the Bay. Stratigraphy of the rest of the Cenozoic is reviewed. The major orogenic epoch in the Coast Ranges was in Pliocene–Pleistocene time. Major earthquakes and accompanying fault movement are described.—E.S.L.

9440 **Ochoterena F., Hector.** Amonitas del Jurásico Medio de México—[Pt.] 2, *Infrapatoceras* gen. nov. [with German abs.]: México Univ. Nac. Autónoma Inst. Geología Paleontología Mexicana, no. 23, 18 p., illus., 1966.

The spiroceratid ammonite cephalopod *Infrapatoceras biserratum*, n.gen.,n.sp., is described from the Middle Jurassic Yucunuti Formation in northeastern Guerrero, type locality, and in northwestern Oaxaca. Loosely coiled in one plane, it closely resembles *Parapatoceras and Metapatoceras* externally, but has a more primitive suture line; the spiroceratid suture line undergoes evolutionary simplification, with reduction of incisions in the lobes and saddles, from *Apsorroceras* through *Metapatoceras*. The Spiroceratidae probably are derived from *Parastrenoceras* (Parkinsonidae). In *Infrapatoceras*, the ontogenetic development of a parapatoceras-type suture line is known for the first time. Shell structure and sediment character suggest that these were vagile neritic organisms of the sea bottom, deposited where they died.—V.M.J.

Odell, J. W. *See* Rasmussen, W. C. 8977

9393 **O'Donoghue, Catherine; Brady, Sharon.** Introduction, *in* Phosphate and potash—Minerals to feed the world: Mining Eng., v. 18, no. 10, p. 76–79, illus., tables, 1966.

Between 1950 and 1965, the fertilizer industry consumed more than 80 percent of the phosphate rock and 95 percent of the potash produced in the world. The "population explosion" factor coupled with the constant search for new fertilizer products with a higher nutritional yield per unit will cause future trends in these two commodities to be dominated by the fertilizer market. World production and consumption statistics (1955–1965), and projected future trends are given.—F.C.C.

Oertel, Gerhard. *See* Craig, Gordon Younger. 9073

9411 **Ohio Division of Geological Survey.** Development, utilization, and stratigraphy of industrial minerals in northeastern Perry and southwestern Muskingum Counties—Ohio Acad. Sci., Sec. Geology, Guide to 41st Ann. Field Conf. 1966: [Columbus] Ohio Acad. Sci., 17 p., illus., 1966.

Several industrial operations (silica, cement, etc.) utilizing raw materials from rocks of the Upper Mississippian and the lower Pottsville Group were visited. Rocks from the Pennsylvanian Middle Kittaning coal down to the Mississippian Logan Formation are exposed in numerous road cuts along the field trip route, and the Mississippian–Pennsylvanian contact is readily recognizable. Stratigraphic relations in the principal roadcuts are illustrated by sketches and columnar correlation sections. Two measured sections from shale and sandstone quarries are appended.—V.M.J.

9384 **Olsen, David A.; Holland, Charles T.** Effect of moisture on pillar design [abs.]: Mining Eng., v. 18, no. 12, p. 48, 1966.

9462 **Olsson, Ingrid U.** C^{14}-och H^3-mötet i Pullman, Washington, USA, 7–11 Juni 1965: Geol. Fören. Stockholm Förh., v. 88, no. 2, p. 283–286, 1966.

This is a report on the international carbon-14 and tritium conference held at Washington State University in June 1965. Radiocarbon techniques, fundamentals of radiocarbon dating (behavior of C-14/C-12, half-life of C-14), effects of nuclear bombs on atmospheric C-14, geological and archeological applications, and tritium were discussed.—D.B.V.

9295 **Oman, Carl H.** A stratigraphic note on the Lisbon Formation of Alabama, *in* Facies changes in the Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. 38-40, illus., 1966.

This dominantly marine middle Eocene sequence of fossiliferous clays, sands and marls crops out across southern Alabama and Georgia, eastward grading downdip into limestones in Florida. The Libson Formation rests disconformably on the Tallahatta Formation, and in western Alabama is overlain disconformably by the Gosport Sand which pinches out at the Alabama River where the Moodys Branch Formation overlies it. At the type locality the Lisbon thickness is about 115 feet, but in outcrop varies from 0 to 150 feet; in general it represents fairly stable shallow marine, shelf-type deposition. Biostratigraphically it may be divided into three distinct zones—open marine, shallow, and major transgressive—distinguished by foraminiferal fauna named herein. Evidence is given for a possible upper Lisbon strait cutting Florida off from the mainland.—G.D.C.

Orange, A. S. *See* Brace, W. F. 9311

8902 **Oriel, Steven S.; Armstrong, Frank C.** Times of thrusting in the Idaho-Wyoming thrust belt—Reply [to discussion of 1965 paper by E. W. Mountjoy, 1966]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2614-2621, 1966.

Paucity of precise dates inhibits recognition of thrust events; a date for a frontal fault does not establish times of thrusting for an entire mountain system. Movements of enormous thrust plates require time spans that exceed geologic intervals resolvable by stratigraphic paleontology. Recurrent movement complicates dating of thrusting, as may the possibility that different parts of a single thrust sheet moved at different times. Pre-Eocene movements are established for the Hogsback thrust (Paleocene) and the Absaroka thrust (latest Cretaceous) and are probable for the Paris thrust (earliest Cretaceous). The LeBarge thrust moved mainly in early Eocene. Data support increasing ages for principal movements of the Idaho-Wyoming thrust faults from east to west, eastward progression of orogeny in the Cordilleran region, and the concept of multiple nonsynchronous tectonic events in history.—S.S.O.

Orme, G. R. *See* Fruth, L. S., Jr. 9034

9199 **Osterwald, F. W.; Dunrud, C. R.** Instrumentation study of coal mine bumps, Sunnyside district, Utah, *in* Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, p. 97-110, illus., 1966.

Coal mine bumps have been a problem in this district since mines were first opened in 1899. Seismic monitoring and tiltmeter investigations are yielding geologic information that could not have been otherwise obtained. Results indicate that many earth tremors are related to large-scale mining of coal, and occurrence of bumps is related to tremors. Those of small amplitude are most abundant during the middle of a work week; large ones are most common on weekends in the northern part and mid-week in the southern part of the district. Many tremors are generated along faults where stresses may be concentrated. Different patterns of occurrence, north and south, seem to be related to different fault patterns and to different methods of mining.—G.D.C.

9144 **Ostrom, John H.** Functional morphology and evolution of the ceratopsian dinosaurs: Evolution, v. 20, no. 3, p. 290-308, illus., tables, 1966.

Three evolutionary lineages of Ceratopsia, a suborder of ornithischian reptiles dominant in the terrestrial Upper Cretaceous of North America, are proposed on the basis of frill proportions, jaw mechanics, and dental design. Of post

Protoceratops genera, *Leptoceratops* alone has an extremely short frill and a dental system combining shearing and crushing capacities. The two main lines, culminating in the short-frilled *Triceratops* and the long-frilled *Torosaurus*, have exclusive shearing dentitions. The short-frilled line underwent progressive improvement in jaw mechanics, resulting in greater leverage for the jaw muscles; the long-frilled line did not show comparable improvement in leverage but developed longer frills to support larger external adductor muscles. The ceratopsians probably ate very fibrous cycad or palm fronds.—V.M.J.

9013 **Palmer, Arthur N.** Hydrogeology of Indiana, *in* A survey of Indiana geology [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, p. 75–81, illus., 1966.

Nearly three-fourths of the ground water used in Indiana is obtained from unconsolidated glacial and alluvial deposits. The ground-water provinces correspond roughly to the geomorphic provinces of the state. In the northern glacial province, covered by Wisconsin drift, the best aquifers are glacial outwash and Silurian and Devonian limestones; water from bedrock older than Silurian is too highly mineralized to be potable. In the southern bedrock province, the Paleozoic limestone and sandstone aquifers yield very little water; glacial outwash in the major stream valleys is far more reliable. This province is divided into sections based upon outcrop patterns. Mississippian limestones are characterized by karst, where pollution is a severe problem; ground-water reserves may be defined here in terms of joint systems and erosion levels.—G.D.C.

9254 **Pannella, Giorgio.** Palynology of the Dakota Group and Graneros Shale of the Denver Basin [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1191B, 1966.

9206 **Parks, Oattis E.** Density sorting as indicated by departure from Gaussian curve: Southeastern Geology, v. 7, no. 4, p. 151–157, illus., tables, 1966.

There is a direct correlation between heavy mineral concentration, ϕ size, and slope break. This correlation will be indicated as a departure from the Gaussian, an increase in slope, where there is more than approximately two percent heavy mineral content in any one sand size fraction. Such a departure from the Gaussian may be attributed to density sorting.—Author's abstract

Patalski, R. M. *See* Gray, R. J. 9197

9132 **Patrick, F. W.; Bostick, F. X., Jr.** An investigation of the variable frequency dipole-dipole method for determining subsurface resistivities—U.S. Office Naval Research, Contract Nonr 375(17): Texas Univ. Elec. Eng. Research Lab. Rept. 144, 76 p., illus., tables, 1966.

The theoretical and some of the experimental features of the method are investigated. This is essentially equivalent to determining the fields due to a dipole operated at frequencies ranging from DC to several hundred cycles in the presence of resistive inhomogeneities. Mathematical models consisting of homogeneous, isotropic layers are developed for the case when the source is an horizontal electric dipole and a vertical magnetic dipole. Normalized apparent resistivity curves are developed and compared with the equivalent curves obtained using the DC dipole method and magnetotelluric method. It is shown that under certain conditions the variable frequency dipole-dipole method may be superior to them. Experimental data taken in the Delaware Basin, near Pecos, Texas, is analyzed by comparison to layered models. The resulting models are compared to those obtained from well-logs and magnetotelluric data.—*from* Authors' abstract

9040 **Patterson, J. R.** Space, things, time, and events—An essay on stratigraphy—Discussion [of paper by H. J. Harrington, 1965]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1519–1520, 1966.

Patterson defines his concept of the original definitions of stratified rocks and strata and also discusses the meaning of stratigraphy and its development from William Smith's principles. He seems to support the view that paleontology is a means,

not an end, in stratigraphy. He places the Tremadocian in the Cambrian, as did Lapworth (See Harrington, ibid., v. 49, no. 10, p. 1601–1646, 1965).—M.W.G.

9173 **Peck, John H.** Upper Ordovician formations in the Maysville area, Kentucky: U.S. Geol. Survey Bull. 1244-B, p. B1–B30, illus., 1966.

Upper Ordovician strata in the Maysville area, Kentucky, are divided into five formations. The basal Kope Formation consists of gray calcareous shale with thin layers of interbedded fossiliferous limestone. It is overlain by the Fairview Formation which is made up of closely interbedded fossiliferous limestone, shale, and minor limy siltstone. Above the Fairview are two newly defined map units, the Grant Lake Limestone and the overlying Bull Fork Formation of interbedded shale and limestone. The Preachersville Member of the Drakes Formation, which overlies the Bull Fork, consists of grayish-green calcareous to dolomitic mudstone and minor dolomitic limestone and dolomite.—A.C.S.

Peirce, H. Wesley. *See* Moore, Richard T. 9376

9210 **Pelton, Peter John.** Mississippian rocks of the southwestern Great Basin, Nevada and California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1192B, 1966.

9118 **Perry, Richard B.; Nichols, Haven.** Geomorphology of Amlia Basin, Aleutian Arc, Alaska: Geog. Rev., v. 56, no. 4, p. 570–576, illus., 1966.

Amlia Basin, a bathymetric feature covering some 500 square nautical miles on the Aleutian Ridge, was detected and charted during hydrographic surveys in 1952 and 1953. Many topographic details of this submarine depression, one of the largest in the world, are similar to those of collapse structures observed in volcanic landscapes. A volcano-tectonic collapse with subsequent erosion is suggested for the origin of Amlia Basin because of its shape, its occurrence in a tectonically active area, and the adjacent submarine relief.—Authors' abstract

8983 **Peters, Lewis B., Jr.** Memorial to Luther Eugene Kennedy (1891–1966): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 9, p. 2012–2013, portrait, 1966.

8924 **Peterson, James A.** Sedimentary history of the Sweetgrass arch, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 112–134, illus., 1966.

The sedimentary history of the Sweetgrass arch can be divided into at least eight major environmental episodes, related in part to the effects of regional tectonic growth and climatic patterns: late Precambrian transgression; Cambrian–Ordovician–Silurian transgressive-regressive event; Devonian–Mississippian transgression; Pennsylvanian–Jurassic regression; Jurassic transgression; Morrison–Kootenai continental deposition; Cretaceous transgressive-regressive complex; and Tertiary uplift and erosion. The paleotectonic setting is reviewed. Small isopach maps and cross sections are included.—E.S.L.

9355 **Peterson, M. N. A.** Calcite—Rates of dissolution in a vertical profile in the central Pacific: Science, v. 154, no. 3756, p. 1542–1544, illus., table, 1966.

Rate of dissolution of calcium carbonate (calcite) was determined for a vertical profile 5,000 m deep in the central Pacific by measuring the loss of weight of optical calcite spheres arrayed on a mooring. Waters of the Pacific are undersaturated in all but the upper several hundred meters. A sharp increase in the rate of dissolution occurs at a depth of about 3,700 m, which corresponds closely to the depth below which calcite has been dissolved from the sediments.—Author's abstract

8918 **Péwé, Troy L.** Paleoclimatic significance of fossil ice wedges: Biul. Peryglacjalny, no. 15, p. 65–73, illus., 1966.

To interpret the meaning of fossil ice wedges now found in regions of temperate climate, existing wedges in polar regions were studied. Classification into active,

inactive, and fossil wedges is suggested. Ice wedges are produced by an even more rigorous environment than that required for permafrost, but once formed they may exist in an inactive state in a relatively weak permafrost environment. If they can be proven to have existed in the geologic past, it can be assumed that a mean annual air temperature of -6°C to -8°C, or colder, existed in that area.—E.S.L.

Picard, M. Dane. *See* Tohill, Bruce. 8900

9113 **Picard, M. Dane.** Petrography of Red Peak Member, Chugwater Formation (Triassic), west-central Wyoming: Jour. Sed. Petrology, v. 36, no. 4, p. 904-926, illus., 1966.

The Red Peak is a predominantly red, even-bedded, arkosic siltstone, and sandstone unit. Detrital components are commonly quartz, albite and orthoclase grains, mica flakes, and quartzite and chert fragments. Cements are mostly calcite, dolomite, and gypsum. Gypsum also occurs in beds. Clay minerals are chiefly illite, chlorite, and mixed layer illite-montmorillonite. Dolomite, gypsum, and rocks deposited under more saline conditions increase northwestward. Deposition occurred under conditions of slow accumulation in an arid to semi-arid climate. Source areas had rigorous climates and ranged from high to low relief; they were sedimentary, acid plutonic, and gneiss-schist terranes located at considerable distances to the north, east, and southeast.—R.A.C.

Piety, John. *See* Schink, David R. 8923

8915 **Pilkey, Orrin H.; Rucker, James B.** Mineralogy of Tongue of the Ocean sediments: Jour. Marine Research, v. 24, no. 3, p. 276-285, illus., table, 1966.

The carbonate mineralogy of 25 short cores from the Tongue of the Ocean has been determined. Evidence presented indicates that carbonate mineralogy may reflect Pleistocene sea-level changes due to an increased contribution of low magnesium calcite from the subaerially exposed Bahama Banks when sea levels were low. It is suggested that this relationship of mineralogy to sea level may find wide application in the study of carbonate sedimentation in intermediate-depth water, proximal to carbonate banks.—Authors' abstract

9434 **Pincus, Howard; Dobrin, Milton B.** Geological applications of optical data processing: Jour. Geophys. Research, v. 71, no. 20, p. 4861-4869, illus., 1966.

It is shown how a recently developed method for optical processing of seismic data can be applied to the study of some common types of geologic phenomena observed in aerial photographs or thin sections. A photograph, map, or drawing is reproduced as a reduced transparency through which laser light is passed; the diffraction pattern or Fourier transform thus produced displays the statistical distribution of directional and spatial frequencies associated with all elements in the photograph, map, or drawing. Lineations of any desired direction or spatial frequency can be filtered out to reveal weakly developed features. The method is also promising for grain size analysis and comparison of contour patterns.—D.B.V.

9176 **Poag, C. W.** Paynes Hammock (Lower Miocene?) foraminifera of Alabama and Mississippi: Micropaleontology, v. 12, no. 4, p. 393-440, illus., 1966.

One hundred thirty-eight foraminiferal species from the Lower Miocene(?) Paynes Hammock Formation of Alabama and Mississippi are described and illustrated, including thirty-two new species and the new genus *Arcanispira*. Several taxonomic changes are suggested for well-known Gulf Coast species. The fauna is compared with Recent assemblages in the near-shore northeastern Gulf of Mexico. Correlation is suggested with faunas of outcropping and subsurface beds in the Gulf Coastal Province and Trinidad.—Author's abstract

Poldervaart, Arie. *See* Larson, Leonard H. 8970

Pomeroy, Paul W. *See* Liebermann, Robert C. 9131

Poole, W. H. *See* McCartney, W. D. 9405

Popenoe, W. P. *See* Dailey, Donald H. 9061

Poulton, C. E. *See* Tisdale, E. W. 9399

Price, Llewellyn I. *See* Stovall, J. Willis. 9360

9374 **Proctor, Richard J.; West, Lawrence J.** The importance of geology in the routing and construction of tunnels—Some examples [abs.]: Mining Eng., v. 18, no. 12, p. 45–46, 1966.

9435 **Pye, E. G.; Harris, F. R.; Fenwick, K. G.; Baillie, J.** (compilers). Tashota Geraldton sheet, Thunder Bay and Cochrane Districts: Ontario Dept. Mines Map 2102, scale 1:253,440, sections, text, 1966.

The Tashota–Geraldton map area contains deposits of asbestos, beryl, copper, gold, gravel, iron, lead, lithium, marl, molybdenum, nickel, pyrite (sulfur), silver, tin, and zinc. A total of 19 mines have produced precious metals since 1931; to the end of 1964 the value of their production was about 12 million dollars.—M.C.M.

8937 **Radella, Frank A.; Galuska, George R.** The Swift Formation of Flat Coulee oil field, Liberty County, Montana, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 202–219, illus., 1966.

Production in the Flat Coulee oil field, in the Sweetgrass Hills of the arch, is from two lenticular, porous sandstone bodies of the Jurassic Swift Formation and averages 726 bbls per day. A lateral change from porous to nonporous rocks draping over a structural nose forms the trap. Gas is present, but is not produced. The stratigraphy of the Swift, especially the pay sands, is discussed and illustrated by five cross sections. Isopach and structure contour maps are included.—E.S.L.

9142 **Radinsky, Leonard B.** The adaptive radiation of the phenacodontid condylarths and the origin of the Perissodactyla: Evolution, v. 20, no. 3, p. 408–417, illus., 1966.

The mammalian order Perissodactyla is shown, by dental evidence, to have been derived from the middle Paleocene *Tetraclaenodon*, oldest genus of the family Phenacodontidae, order Condylarthra. *Tetraclaenodon* gave rise to three late Paleocene groups, represented in North America by *Phenacodus and Ectocion*, and by a yet unknown form which evolved rapidly into the early Eocene *Hyracotherium*, the most primitive perissodactyl. Specializations for mastication and locomotion, the main morphological changes indicated by fossil evidence of this evolutionary radiation, are here outlined.—V.M.J.

9081 **Ramsden, A. R.; Cameron, E. N.** "Kamacite and taenite superstructures and a metastable tetragonal phase in iron meteorites"—Correction: Am. Mineralogist, v. 51, nos. 9–10, p. 1544–1545, 1966.

"The suggested existence of a metastable tetragonal phase in iron meteorites is incorrect [see, ibid., p. 37–55, 1966]. Subsequent investigation has indicated misalignment of the collimator in the X-ray powder camera, and the lines attributed to the tetragonal phase have been positively identified as due to the plasticene in which the short fibers were mounted."—*from* Authors' note

Randall, Allan D. *See* Thomas, Chester E., Jr. 9019

9364 **Randich, P. G.; Hatchett, J. L.** Geology and ground water resources of Burleigh County, North Dakota—Pt. 3, Ground water resources: North Dakota Geol. Survey Bull. 42, pt. 3 (North Dakota Water Conserv. Comm. County Ground Water Study 3), 92 p., illus., tables, 1966.

Burleigh County ground-water resources are obtained from Cretaceous and Tertiary bedrock and Quaternary drift and alluvial deposits. Bedrock aquifers are more

widely distributed, but drift and alluvial aquifers provide higher yields and better quality water. About 70 percent of domestic and stock wells obtain water from Tertiary and Cretaceous deposits, generally at depths of less than 300 feet. About 7 million acre-feet of water is stored in the 15 Quaternary drift and alluvial aquifers underlying almost 150,000 acres; about half would be available to properly constructed wells. The study indicates that a large quantity of water is continuously moving in, through, and out of the aquifer system; 14 irrigation wells are producing from 200 to more than 2,000 gpm each from drift and alluvial aquifers.—*from* Authors' abstract

Rankin, Douglas W. *See* Neuman, Robert B. 8906

9438 **Rapoport, Eliezer.** Polymorphism and melting in the alkali nitrates to 40 kb with some comments on the alkaline earth carbonates: Jour. Physics and Chemistry Solids, v. 27, no. 8, p. 1349–1363, illus., tables, 1966.

Phase diagrams of alkali nitrates were determined by differential thermal analysis to 40 kb and 700°C. $LiNO_3$ shows no polymorphic transitions; an equation is given for effect of pressure on gradual transition in $NaNO_3$; their melting curves are very similar. The latter flattens considerably at higher temperature and cannot be fitted to the Simon equation. This might indicate an approach to a maximum in the melting curve similar to the one found in KNO_3. Curves of other nitrates rise steeply with pressure. Comparison is made with the alkaline earth carbonates and a tentative phase diagram is proposed for $CaCO_3$ based on the analogous KNO_3 diagram and experimental data. Knowledge of phase diagrams and structural relations in the nitrates might broaden the understanding of phase equilibria in the earth carbonates.—G.D.C.

8977 **Rasmussen, W. C.; Odell, J. W.; Beamer, N. H.** Delaware water: U.S. Geol. Survey Water-Supply Paper 1767, 106 p., illus., 1966.

Written in nontechnical language, this report concerns the significance of water, the environment of Delaware, streamflow, contamination and pollution, estuarine and marine conditions, the 12 principal ground-water reservoirs, and what the future holds for the state in regard to its water problems.—M.C.M.

9048 **Rau, Weldon W.** Stratigraphy and Foraminifera of the Satsop River area, southern Olympic Peninsula, Washington: Washington Div. Mines and Geology Bull. 53, 66 p., illus., tables, geol. map, 1966.

Satsop River area is underlain by 13,000 feet of south-dipping Tertiary marine strata. The oldest rocks, referred to the middle Eocene Crescent Formation, are unconformably overlain by rocks of late Eocene age; the overlying Lincoln Creek Formation comprises one of the thickest and most complete sections of rock of the Refugian and Zemorrian Stages in western Washington. The Astoria(?) Formation, referred to Saucesian and considered early Miocene, is present in a small area. The Montesano Formation overlies unconformably both the Astoria(?) and Lincoln Creek Formations, and is regarded as late Miocene or early Pliocene. Paleoecologic conditions were relatively uniform throughout much of Tertiary time; upper bathyal to lower neritic depths prevailed and water temperatures were cool to cold. Shoaling conditions existed during deposition of the Montesano Formation.—B.S.H.

Read, Charles B. *See* New Mexico Geological Society. 9181

9020 **Redman, Robert H.** Simple technique for illustrating porosity distribution and textural properties of slabbed cores: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2611, 1966.

Excellent results have been obtained in reproducing the megascopic characteristics of sections of cores by using the Xerox 914 copying machine. Polishing is not necessary but wetting the core surface with water or glycerin results in clearer reproduction.—S.P.S.

9263 **Reichert, W. H.** Carbon dioxide (CO_2), *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 175–177, tables, 1966.

"Springs that produce water containing carbon dioxide in Washington are in the following counties: Chelan, Cowlitz, King, Klickitat, Lewis, Pierce, Skamania, Snohomish, and Yakima. Commercial utilization of the CO_2, however, has been successful only at the Klickitat Mineral Springs." Production figures for the Klickitat operation are given in this report.—W.L.G.

Reinhardt, E. W. *See* Wynne-Edwards, H. R. 9226

Renton, J. J. *See* Heald, M. T. 9111

Reynolds, Robert C. *See* Anderson, Duwayne M. 9039

9253 **Reynolds, William R.** Formation of cristobalite, zeolite and clay minerals in the Paleocene and lower Eocene of Alabama [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1192B, 1966.

9294 **Reynolds, William R.** Stratigraphy and genesis of clay mineral and zeolite strata in the lower Tertiary of Alabama, *in* Facies changes in the Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. 26–37, illus., 1966.

Clay minerals and zeolites in lower Tertiary sediments of Alabama were formed in place and deposited without subsequent change. Montmorillonite is detrital in the Naheola and Hatchetigbee Formations and the Tuscahoma Sand. The zeolites clinoptilite and heulandite plus montmorillonite, diagenetic in the Pine Barren Member of the Clayton, lower clays of the Porters Creek, Grampian Hills Member of the Nanafalia, and Tallahatta Formations, are believed to have been formed by chemical alteration of volcanic ash. Cristobalite in the Pine Barren and Grampian Hills Member is either a byproduct from the development of montmorillonite from volcanics or a primary constituent. It also occurs as thick beds in the Tallahatta Formation and is believed to be a primary constituent.—*from* Author's abstract

9114 **Rhoads, Donald C.; Stanley, Daniel J.** Transmitted infrared radiation—A simple method for studying sedimentary structures: Jour. Sed. Petrology, v. 36, no. 4, p. 1144–1149, illus., 1966.

A photographic method employing infrared sensitive film, a tungsten filament light source, and an ordinary camera detects organic and bedding structures not visible in ordinary light in rock slices 1 to 6 mm thick.—R.A.C.

Richardson, E. V. *See* Simons, D. B. 9473

Rigby, J. Keith. *See* Hamblin, W. K. 9202

9290 **Riley, W. F.; Dally, J. W.** A photoelastic analysis of stress wave propagation in a layered model: Geophysics, v. 31, no. 5, p. 881–899, illus., table, 1966.

Dynamic photoelasticity was used to study some fundamental aspects of wave propagation in layered media and to obtain information on the dynamic state of stress associated with the various waves generated by a point source explosion. Six different wave types were identified. Near the source, the incident P_1 and reflected P_1S_1 waves from the interface and the free boundary predominated. Away from the source the headwaves ($P_1P_2S_1$, $P_1S_2P_1$, and $P_1S_2S_1$) dominated, as their rate of attenuation is much lower than the rate associated with the incident dilatational or the reflected shear waves. The data obtained in the form of isochromatic fringe patterns were converted to individual values of the principal stresses in several instances.—D.B.V.

9125 **Ringwood, A. E.; Major, Alan.** Some high-pressure transformations in olivines and pyroxenes: Jour. Geophys. Research, v. 71, no. 18, p. 4448–4449, 1966.

Preliminary results of experiments are presented which suggest that $MgSiO_3$ pyroxene will probably transform into a mixture of Mg_2SiO_2–spinel+stishovite at high pressures, and that the pressure required may be substantially higher than required for the olivine–spinel transformation in pure Mg_2SiO_4.—D.B.V.

9323 **Riva, John.** New assemblages of Middle Ordovician graptolites from the Appalachian region, Quebec [with French abs.]: Naturaliste Canadien, v. 93, no. 2, p. 153–156, table, 1966.

Graptolite assemblages from the Etchemin River between St. Henri and St. Anselme and from the St. Francois River at and near Drummondville indicate a similarity in faunas from both the Middle Ordovician rocks of the Appalachian province in Quebec and the Normanskill Shale of the same tectonic province in New York. The graptolite-bearing exposure consists of medium grained black sandstones, black to greenish chert, and black sooty and locally pyritic shale. A table listing the species and their relative frequency is included.—B.S.H.

9448 **Robert, Jean-Louis.** Geology of Mount Hog's Back area, Gaspé North county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 540, 24 p., table, geol. map, revised 1966.

Devonian sedimentary rocks of this area are folded into an anticline and syncline. The anticline, covering the south half of the map-area, represents the north portion of Lemieux dome and gives way to the transversal syncline to the north. A band of Silurian rocks, cut off by several acid intrusions, crosses the northern part. Intrusions and lava flows also appear in the anticline, and a part of the Mount Albert ultrabasic mass is present in the extreme north. Mineralization is discussed and shown on the geologic map. This report replaces the 1965 edition.—E.S.L.

9045 **Roberts, Ralph J.; Crittenden, M. D., Jr.; Tooker, E. W.; Morris, H. T.; Hose, R. K.; Cheney, T. M.** Reply [to discussion by W. P. Hewitt of "Pennsylvanian and Permian basins in northwestern Utah, northeastern Nevada and south-central Idaho," 1965]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1524, 1966.

The authors are pleased that Dr. Hewitt (ibid., p. 1523) has enabled them to acknowledge the extent and excellence of geologic work done by the U.S. Smelting Refining and Mining Co. geologists.—M.W.G.

9378 **Roberts, Ralph J.; Bayley, Richard W.; Moore, William J.** Metallogenic provinces and mineral belts in the western states [abs.]: Mining Eng., v. 18, no. 12, p. 46, 1966.

8922 **Robinson, S. C.** Storage and retrieval of data [with French abs.]: Canadian Surveyor, v. 20, no. 4, p. 269–279, illus., 1966.

Some of the reasons for storing data and nine factors that determine methods used are reviewed briefly. Current methods range from standard filing methods, through edge-punched cards, to those involving machine processing. The principal medium for recording is still the field notebook, perhaps with loose leaves that can be used as punched cards. Some of the newer methods of retrieval and presentation using computers are reviewed.—E.S.L.

9299 **Robinson, S. C.** Memorial to James Edwin Hawley (1897–1965): Geol. Assoc. Canada Proc., v. 17, p. 87–89, portrait, 1966.

Roddick, J. A. *See* Roots, E. F. 9327

9216 **Rogers, Marion Alan.** Organic geochemistry of some Devonian black shales from eastern North America—Carbohydrates [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1192B–1193B, 1966.

Rohrbacker, Timothy J. *See* Hatfield, Craig B. 9366

Romer, Alfred Sherwood. *See* Stovall, J. Willis. 9360

9327 **Roots, E. F.; Green, L. H.; Roddick, J. A.; Blusson, S. L.** Geology, Frances Lake, Yukon Territory and District of Mackenzie: Canada Geol. Survey Prelim. Ser. Map 6-1966, scale 1:253,440, text, 1966.

An ice sheet covered all the highest peaks of the Frances Lake area at least once during the Pleistocene, leaving erratics at elevations greater than 6,600 feet. Unnamed map units are described in some detail. Outside the complexly deformed central crystalline terrain, regional structures trend northwest except in the northern part where they become westerly. Some sphalerite, galena, pyrrhotite, chalcopyrite, and scheelite have been noted and reported, and a high-grade tungsten deposited is being mined.—M.C.M.

9102 **Rose, Francis L.; Weaver, W. G., Jr.** Two new species of *Chrysemys* (= *Pseudemys*) from the Florida Pliocene: Tulane Studies Geology, v. 5, no. 1, p. 41-48, illus., 1966.

Of two fossil tortoises recently excavated from a Pliocene deposit at McGehee Farm near Newberry in Alachua County, *Chrysemys carri* is referrable to the *nelsoni-rubriventris* group; *C. williamsi* shares several characters in common with Recent *C. floridana*, *C. concinna*, and Mexican and Central American members of the *C. scripto ornata* complex. The Thomas Farm (lower Miocene) nuchal elements reported by Williams (1953) are referred to the *nelsoni-rubreventris* group. No convincing evidence supports the thesis that *Chrysemis and Pseudemys* are separate genera.—*from* Authors' abstract

8914 **Rosfelder, André M.; Marshall, Neil F.** Oriented marine cores—A description of new locking compasses and triggering mechanisms: Jour. Marine Research, v. 24, no. 3, p. 353-364, illus., 1966.

While core-orientation data are becoming more and more necessary for marine sedimentological studies, there are no rugged, inexpensive, or convenient compasses that are insensitive to the ambient pressure, the inclination of the corer, and the bottom impact. Some instruments designed in an attempt to overcome these problems—a hemispherical compass, a free-floating spherical compass, an inexpensive "compass smasher", and some proposed simplified models of these—are described. The triggering mechanisms consist basically of a stretched wire fastened to a yielding point on the corer, this point being (1) a glass shear pin snapped off by the sediment, (2) a tiny nose lever turned up in the same way, or (3) a releasing lock positioned on a mobile part of the corer.—*from* Authors' abstract

9116 **Rosfelder, Andre M.** A tubular spring valve used as a tight and thin-walled core-retainer: Jour. Sed. Petrology, v. 36, no. 4, p. 973-976, illus., 1966.

A thin-walled and tight core-retainer, which can be used also as a quick-acting valve for various purposes, was built in different models and successfully tested at sea. It is based on a cloth valve originally adapted to corers by H. Delauze, but twisted in this device by an encasing torsion spring released by a latch. This latch is directly actuated by the sediment during the pull up.—Author's abstract

9356 **Rowe, M. W.; Bogard, D. D.; Kuroda, P. K.** Mass yield spectrum of cosmic-ray-produced xenon: Jour. Geophys. Research, v. 71, no. 19, p. 4679-4684, illus., tables, 1966.

Results of a study of the isotopic composition of xenon have indicated that the two Ca-rich achondrites (Nakhla and Lafayette) that comprise the group of diopside-olivine achondritic meteorites (nakhlites) contain only a very small amount of excess fission-produced xenon. Thus it appears possible to obtain a relatively pure isotopic spectrum of xenon isotopes resulting from cosmic-ray spallation reactions. The mass yield spectrum of spallation xenon normalized to Xe-126 is Xe-124:Xe-126:Xe-128:Xe-130:Xe-131:Xe-132 = 0.57:1.00:1.53: 0.86:2.5:0.60. These values are compared with those obtained by other workers. On the basis of the xenon isotopic abundance it is suggested that Lafayette and Nakhla are identical and do not represent independent falls.—D.B.V.

9425 **Rowe, M. W.; Bogard, D. D.** Isotopic composition of xenon from Ca-poor achondrites: Jour. Geophys. Research, v. 71, no. 17, p. 4183–4188, illus., tables, 1966.

The isotopic composition of xenon extracted from 6 samples of 5 Ca-poor achondrites is presented. The data suggest that the principal component in all the samples studied here (except Shallowater) is probably atmospheric xenon, which is simply adsorbed onto the meteorite, presumably during the terrestrial life of the sample. A quite high Xe-129/Xe-130 ratio is observed in xenon from the Shallowater enstatite achondrite, which contained relatively large amounts of primordial xenon compared to the other Ca-poor achondrites. The large special anomaly is thought to imply a genetic relationship between the enstatite achondrites and enstatite chondrites.—Authors' abstract

Rowe, M. W. *See* Kuroda, P. K. 9429

Rucker, James B. *See* Pilkey, Orrin H. 8915

9100 **Runcorn, S. K.** Satellite gravity observations and convection in the mantle, *in* The world rift system—Internat. Upper Mantle Comm. Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–14, p. 364–372 [1966].

It is concluded that the hypothesis of convection shows every indication of providing an explanation of the lower degree harmonics of the Earth's geoid. One may, therefore, look to the increasing development of accurate knowledge of these harmonics, through satellite observations, as a means of investigating the dynamics of the Earth's mantle, and of understanding the origin of tectonic activity.—*from* Author's conclusion

8991 **Ruotsala, A. P.; Koons, G. J.; Nordeng, S. G.** Clay minerals in glacial deposits, Houghton, Baraga, and Ontonogan Counties, Michigan [abs.]: Am. Mineralogist, v. 51, nos. 9–10, p. 1563, 1966.

8912 **Rutter, Nathaniel W.** Glacial history of the Bow River valley, Banff area, Alberta: Canadian Alpine Jour., v. 49, p. 157–173, illus., 1966.

Pleistocene history of the area is interpreted from the deposits of the Bow River valley glacier. Three major glacial advances, the Bow Valley advance, Bow Valley readvance, and Eisenhower Junction advance, are probably correlative with the three stades of the Pinedale Glaciation of the U.S. Rockies; if so, the Bow Valley advance has a maximum age of about 25,000 years. A Pre-Bow Valley advance may be correlated with the late stage of the Bull Lake Glaciation, prior to the Pinedale, about 45,000 years ago. The Eisenhower Junction readvance is believed to have a minimum age of 9,000 years B. P., based on a C-14 date from glacial deposits of upper North Saskatchewan River. Windblown sand and volcanic ash of Altithermal age, between 4,000 and 6,500 years B.P., overlie Bow Valley advance and readvance deposits.—V.M.J.

9287 **Ryall, Alan; Slemmons, David B.; Gedney, Larry D.** Seismicity, tectonics, and surface faulting in the western United States during historic time: Seismol. Soc. America Bull., v. 56, no. 5, p. 1105–1135, illus., table, 1966.

Maps of tectonic flux are presented for the western United States for the historic period through 1961. The broad areal extent of seismic zones suggests that tectonic processes causing earthquakes and surface faulting in western United States are distributed over broad regions and not confined to geologic or physiographic provinces. Recurrence curves indicate a high level of activity for the Ventura-Winnemucca zone and the lowest rate for the San Andreas fault zone; in central California the rate of activity in a given region may remain constant for long periods whether or not large earthquakes occur during those periods. Historic faulting in areas with little or no seismic activity is attributed to the propagation of fractures into those areas from adjoining seismic zones.—D.B.V.

9166 **Sainsbury, C. L.** Tin, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 145–147, illus., 1966.

In Washington lode deposits of stannite and cassiterite are reported to occur at 14 places, of which 4 localities are not confirmed. The commonest type of deposit contains stannite associated with other sulfide minerals in veins in granite, granodiorite, or sedimentary or metamorphic rocks. Of the known tin deposits, only those at Silver Hill, in Spokane County (cassiterite in pegmatites), have been explored sufficiently to determine ore reserves.—W.L.G.

9351 **Saint-Onge, D. A.** Geomorphology of the Lancer area, Saskatchewan [with French abs.]: Rev. Géographie Montréal, v. 20, nos. 1–2, p. 27–45, illus., 1966.

Geomorphologic mapping techniques used by the author in a study of an Arctic area, Ellef Rignes Island (1965), are modified for application, on an experimental basis, to the Lancer map-area in the semiarid zone of southwestern Saskatchewan. The map constitutes terrain description incorporating data on three-dimensional aspects of landforms and surface materials, on genesis of these features, and on chronology of events which have affected the area. Eolian, glacial, glacial-lake, and fluvial features shown on the map are also discussed in the text. The terms Lancer, Cramersburg, and Recent denote Quaternary chronological phases: Lancer refers to features formed concurrently with a high-level ice-dammed lake, 2,250 feet a.s.l., formed after ice retreat from the Lancer Moraine; Cramersburg refers to the later lower level of the lake, 2,130 feet a.s.l.—V.M.J.

9208 **Sanders, Robert B.** Technique for mounting saccate pollen grains: Oklahoma Geology Notes, v. 26, no. 10, p. 257–258, 1966.

Hoyer's solution, stained dark red with Bismarck brown Y, has proved to be the most satisfactory mountant for saccate pollen grains. It eliminates distortion of grains, which absorb enough stain to make them stand out distinctly.—E.S.L.

9432 **Savage, J. C.; Hastie, L. M.** Surface deformation associated with dip-skip faulting: Jour. Geophys. Research, v. 71, no. 20, p. 4897–4904, illus., 1966.

A fault surface may be represented by a rectangular surface of horizontal length 2L, width W, and dip δ embedded in an elastic half space with the top of the fault at a depth h below the free surface. The vertical displacement of the free surface for a dip slip motion Δu on such a fault surface can be calculated from Maruyama's theory. This calculation is made for fault models of the Alaskan earthquake of March 1964, the Fairview Peak (Nevada) earthquake of December 1954, and the Hebgen Lake (Montana) earthquake of August 1959, and the results are compared with the observed surface deformation in each case. Each of the dislocation models is unsatisfactory in some respect, but they all indicate that faulting was confined to the crust and did not penetrate the mantle.—D.B.V.

Sawatzky, P. *See* Collett, L. S. 9237

Schafer, Charles. *See* McCrone, Alistair W. 9169

Schapiro, N. *See* Gray, R. J. 9196

Schapiro, N. *See* Gray, R. J. 9197

Schiller, E. A. *See* Taylor, F. C. 8998

8923 **Schink, David R.; Fanning, Kent A.; Piety, John.** A sea-bottom sampler that collects both water and sediment simultaneously: Jour. Marine Research, v. 24, no. 3, p. 365–373, illus., table, 1966.

A simple sampler, assembled mainly from commercially available equipment, is described. It simultaneously collects water samples at 1, 2, 3, 4, 5, and 6 m above the sea floor and takes a short core at the same location.—Authors' abstract

9214 **Schirk, G. V.; Lynott, T. P.** Water resource development other than for municipal water supply and hydroelectric power, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 371–436, illus., tables, 1966.

This part of the report describes, in summary form, water resource developments in Washington exclusive of hydroelectric power and municipal and industrial water supply. Existing information and data are brought together to show the magnitude and types of major existing development and to furnish some indication of potentialities to be realized primarily for agricultural purposes. Agricultural regions are consolidated into six primary subbasins to facilitate the compilation and presentation of information. The location, number, and relation of the various subbasins within the State and their relation to other parts of the Columbia River basin are shown on a map. Also included is a brief summary of the history of land and water use.—W.L.G.

8986 **Schleh, E. E.** Review of sub-Tamaroa unconformity in Cordilleran region—Errata: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1524–1525, 1966.

In paraphrasing C. A. Sandberg's statements, on page 276 of the paper under discussion (ibid., v. 50, no. 2, p. 269–282, 1966), the author erroneously substituted the term "Sappington" for "the dark shale unit." The major regional unconformity is the one beneath the dark shale unit, and not the one beneath the Sappington.—M.W.G.

9252 **Schnable, Jon Edwin.** The evolution and development of part of the northwest Florida coast [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1193B, 1966.

9007 **Scholl, David W.; Buffington, Edwin C.; Hopkins, David M.** Exposure of basement rock on the continental slope of the Bering Sea: Science, v. 153, no. 3739, p. 992–994, illus., 1966.

Reflection profiles reveal that the Bering continental slope, outer shelf, and rise are underlain by a reflective "basement" which extends at least 750 km parallel to the trend of the slope and is exposed in submarine canyons and flanking spurs along the main part of the slope for at least 550 m northwest of the Pribilof Islands. The velocity of 3.1–3.7 kmps suggests that it is composed of volcanic rocks or lithified sediments or both: the regional geology suggests that it is the upper surface of folded late Mesozoic rocks locally intruded by granite and serpentine. The basement surface appears to have been monoclinally flexed and faulted between the shelf edge and the deep Aleutian Basin.—D.B.V.

9427 **Schopf, James M.; Mencher, Ely; Boucot, Arthur J.; Andrews, Henry N.** Erect plants in the Early Silurian of Maine, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-D, p. D69–D75, illus., 1966.

Small, erect plant axes, referred to *Eohostimella* Schopf, n. gen., occur in a Lower Silurian deposit in northern Maine. Surfaces are spinulate, and the cortical outer layer is persistent and generally coalified. This outer layer evidently consists of mechanical tissue to account for the erect posture of the axes. No trace of vascular tissue has been observed in a large suite of material, suggesting that any possible conducting strand was delicate and simple. These fossils may represent a primitive type of land vegetation in which the mechanical function of cortical tissue was more advanced than the conductive, or vascular, specialization. Other plant remains in the deposit are not erect and probably represent foliose algae.—Authors' abstract

8936 **Schulte, John J.** Correlation of the Sunburst zone with the Second Cat Creek zone in northwestern and central Montana, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 220–223, illus., 1966.

The Sunburst zone is defined to include the oil-bearing sandstone of the same name at the base of the Cretaceous Kootenai, and the lithologic break that sometimes occurs above it. The zone is a metabentonite with erratic sandstone lenses, contains

scattered bright orange-red chert grains, and could be recognized in 47 sample cuttings from other parts of Montana and in surface outcrops; it is equivalent to the Second Cat Creek sand producing in central Montana. The Greybull sandstone has the same lithology, and it is suggested that it also is equivalent to the Sunburst zone.—E.S.L.

9436 **Sclar, C. B.; Carrison, L. C.; Gager, W. B.; Stewart, O. M.** Synthesis and stability of a high-pressure polymorph of sulfur: Jour. Physics and Chemistry Solids, v. 27, no. 8, p. 1339–1343, illus., tables, 1966.

A new quenchable polymorph of sulfur has been prepared under high pressure and elevated temperature. It is stable between 300°C and the liquidus in the pressure range 30–60 kb and is characterized by unique X-ray powder diffraction data and special optical properties. The phase is uniaxial positive and shows essentially total absorption and total transmission of polarized white light vibrating parallel and perpendicular to the optic axis, respectively. It gives a symmetrical electron spin resonance line with $g = 2.0036 \pm 0.0005$. It is suggested that this form of sulfur, which gradually transforms at room conditions to the ordinary orthorhombic form, may have a chainlike molecular structure as opposed to the closed ring structure of ordinary orthorhombic sulfur.—G.D.C.

9251 **Scott, Martha Lyles Richter.** Distribution of clay minerals on the British Honduras shelf [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1193B, 1966.

Seewald, Clyde R. *See* Kohls, Donald W. 8898

Senftle, F. E. *See* Lewis, R. R. 9456

9236 **Senich, Donald.** X-ray diffraction and adsorption isotherm studies of the calcium montmorillonite-H_2O system [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1147B, 1966.

9416 **Serata, Shosei.** Application of continuum mechanics to design of deep potash mines in Canada [abs.]: Mining Eng., v. 18, no. 12, p. 44, 1966.

9171 **Setty, M. G. Anantha Padmanabha.** Preparation and method of study of fossil diatoms: Micropaleontology, v. 12, no. 4, p. 511–514, illus., 1966.

Two methods of chemical concentration of diatoms occurring in fresh-water sediments, and one chemico-mechanical method of concentration for diatoms occurring in marine sediments are outlined, with emphasis on the extreme care that needs to be exercised during the preparation of samples. A method for the preparation of strewn slides is then explained. A detailed procedure for the study of diatom-strewn slides under the microscope, using the "England finder", is described, and a note on diatom analysis is added.—Author's abstract

8928 **Shelton, John W.** Stratigraphic models and general criteria for recognition of alluvial, barrier-bar, and turbidity-current sand deposits, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 1–17, illus., table, 1966.

In estimating depositional conditions for ancient sand deposits, significant features must be compared to those of well-documented models. Three such models are described here: for alluvial sand, the Cretaceous Cut Bank sand at the base of the Kootenai on the Sweetgrass arch; for a barrier-bar sand, the lowermost unit in the Cretaceous Eagle Sandstone, Billings area; for a turbidity-current sand, the lower Pliocene Repetto in the Los Angeles basin. The structural and stratigraphic framework, geometry, internal features, and depositional environment are given in detail for each, and criteria for recognition are tabulated.—E.S.L.

Sheridan, Douglas M. *See* Young, Edward J. 9074

Shurtz, Robert F. *See* Verner, William J. 9392

9002 **Sigma Gamma Epsilon, Rho Chapter; Frey, Robert W.; Lane, Richard A.** (editors). A survey of Indiana geology, with road logs for two field trips [revised edition]: Bloomington, Ind., Sigma Gamma Epsilon, Rho Chapter, Indiana Univ. Dept. Geology, 112 p., illus., 1966; originally published 1965.

This edition has been thoroughly rewritten and updated, with several new illustrations and an added paper on paleontology; certain sections have been treated less technically than others, in order to appeal not only to geologists but also to serious laymen. Chapters by a number of individual authors are cited separately. The two field trip guides are for southeastern and southwestern Indiana for examination of exposed stratigraphic units.—G.D.C.

8919 **Silverman, Arnold; Harris, William L.** Economic geology of the Great Falls Lewistown coal field, west-central Montana, *in* Symposium, Jurassic and Cretaceous stratigraphic traps, Sweetgrass arch—Billings Geol. Soc., 17th Ann. Field Conf. 1966, Guidebook: Billings, Mont., Billings Geol. Soc., p. 149-163, illus., tables, 1966.

The coal field lies on the north flanks of the Little Belt and Big Snowy Mts., and can be separated into a number of basins. The coal beds occur in a continental sequence of the Morrison Formation, and the coal interval between basins is carbonacous shale. The basal Kootenai sandstone overlies the coal interval except where a thin sequence of upper Morrison clastics occurs. Coal beds range from one to seven feet in thickness and most seams have two or three benches. Analyses of the coal are tabulated. It is ranked as Subbituminous B to High-volatile C Bituminous, and is composed mostly of durain and fusain.—E.S.L.

9473 **Simons, D. B.; Richardson, E. V.** Resistance to flow in alluvial channels: U.S. Geol. Survey Prof. Paper 422-J, p. J1-J61, illus., tables, 1966.

Flume and field studies have proved that bed configuration in alluvial channels will be ripples, ripples on dunes, dunes, plane bed, antidunes, chutes and pools, or some combination thereof. Bed forms and resulting resistance to flow vary with slope of the energy grade line, depth of flow, fall velocity, physical size and gradation of bed material, seepage force, and shape and sinuosity of the channel. Although depth, slope, and fall velocity are primary factors in determining resistance to flow, effects of other variables are not inconsequential. Fine sediment dispersed in water has a definite effect on viscosity and specific weight of the fluid mixture, and thus on fall velocity, bed configuration, resistance to flow, and sediment transport. Methods presented for estimating resistance to flow and average velocity of flow are applicable to most types of roughness in all types of channels, flumes, canals, and rivers.—*from* Authors' abstract

9380 **Simpson, Thomas A.** A case study in mining hydrology methods [abs.]: Mining Eng., v. 18, no. 12, p. 47, 1966.

9088 **Sinclair, G. Winston.** Memorial to Alice E. Wilson (1881-1964): Geol. Soc. America Bull., v. 77, no. 11, p. P215-P218, portrait, 1966.

Singh, M. M. *See* Brown, J. W. 9053

Siple, George E. *See* Butler, J. Robert. 9047

9051 **Slavin, Walter.** Atomic-absorption spectroscopy—A critical review: Appl. Spectroscopy, v. 20, no. 5, p. 281-288, tables, 1966.

Atomic-absorption spectroscopy is reviewed as an analytical technique. The effect of recent instrumental advances on analytical procedures is reported. It is now possible to determine every metal and semi-metal for which lamps have been made. Analytical procedures by atomic absorption are generalized and limitations of the technique stated. The various instrumental techniques for metal analysis are compared to show for what purposes atomic absorption is useful. Applications in various analytical fields are mentioned briefly.—Author's abstract

Slemmons, David B. *See* Ryall, Alan. 9287

9293 **Smith, Charles C.** Foraminifera, biostratigraphy, and paleoecology of the "*Ostrea thirsae* beds", Nanafalia Formation, west-central Alabama, *in* Facies changes in the Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. 20–25, illus., 1966.

The Wilcox Group in Alabama, even with widespread and abundantly fossiliferous marine beds, lacks the paleontologic attention it deserves, partly due to its generally nonmarine character. A micropaleontological study in Marengo and Wilcox Counties, synthesized herein, documents the foraminiferal fauna and age determination of the "*Ostrea thirsae* bed" at its type locality and in its classic area of west-central Alabama; 18 planktonic species and 72 benthonic species are recognized. Several of the planktonic species make possible a biostratigraphic correlation with beds of the *Globorotalia pseudo-menardi* zone of Trinidad. The fauna indicate a shallow marine depositional environment; the planktonic-benthitic ratio suggests middle-neritic. Compared with Recent oyster reefs, reefal accumulation was in water depths no greater than 30 feet.—G.D.C.

9221 **Smith, George I.** Geochemistry of Searles Lake evaporites, California [abs.]: Mining Eng., v. 19, no. 1, p. 62, 1967.

Smith, Stuart M. *See* Menard, H. W. 9070

9362 **Smith, W. Calhoun.** Geologic factors in dam and reservoir planning: Illinois Geol. Survey Environmental Geology Note 13, 10 p., 1966.

The planning of dam and reservoir sites must include careful consideration of the geologic environment. Knowledge of the principal elements of this environment—topography, hydrology, and geology—contributes to the success of a project. Various conditions in bedrock and unconsolidated deposits, such as discontinuities and the presence of shale or cavernous limestone, lead to problems in dam and reservoir construction and maintenance. Availability of construction materials, the effect of the project on the area's mineral resources, and the balance between site quality and budget, are economic aspects of dam and reservoir planning for which geologic considerations are important.—Author's abstract

Snavely, P. D., Jr. *See* Wagner, H. C. 9151

9250 **Snowden, Jesse Otho, Jr.** Petrology of Mississippi loess [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1193B–1194B, 1966.

9165 **Staatz, M. H.** Thorium and the rare earths, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 141–145, illus., 1966.

"Washington has never been a producer of either thorium or the rare earths. Small amounts of these elements are known, however, from several types of deposits in the State;" the localities are shown on a map.—W.L.G.

Stager, J. K. *See* Mackay, J. Ross. 8917

Stanley, Daniel J. *See* Rhoads, Donald C. 9114

9249 **Stanley, Donald Alvora.** A preliminary investigation of the low-sodium portion of the system BeO-Na_2O-SiO_2-H_2O [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1194B, 1966.

9412 **Stevenson, John S.; Stevenson, Louise S.** Fluorine content of microsaur teeth from the Carboniferous rocks of Joggins, Nova Scotia: Science, v. 154, no. 3756, p. 1548–1550, illus., 1966.

Because the Carboniferous deposits at Joggins, Nova Scotia, contain the earliest fauna of terrestrial vertebrates, the extremely well-preserved teeth of these ancient animals are of special interest. The "mineral" composition of teeth from the Joggins

microsaur *Hylerpeton dawsoni* is crystallochemically identical with francolite, a carbonate fluorapatite. The fluorine content of the fossilized dentin is 3.1 percent, which is much higher than any previously recorded for fossil teeth.—Authors' abstract

Stevenson, Louise S. *See* Stevenson, John S. 9412

Stewart, G. L. *See* Hoffman, C. M. 9343

9439 **Stewart, Herbert G., Jr.** Ground-water resources of Polk County: Florida Geol. Survey Rept. Inv. 44, 170 p., illus., tables, 1966.

Domestic and small irrigation supplies of water are obtained from limestones of the Miocene Hawthorn Formation and from unconsolidated clastic deposits. Large supplies are from the Floridan aquifer. Geologic studies near Lakeland show the Avon Park Limestone is the lowest unit of the Floridan and there has been no circulation of ground water in the underlying formations. Floridan rocks have been highly fractured, resulting in solutional development of limestone and extensive cavern systems and free circulation of water between all units of the aquifer. Water recharges the Floridan principally by downward percolation from surficial sands and through intervening units. During 1959 approximately 80 billion gal. of ground water were pumped from the aquifers and approximately 120 billion gal. recharged the limestone aquifers; excess moves through the aquifers into adjacent counties.—*from* Author's abstract

Stewart, O. M. *See* Sclar, C. B. 9436

9375 **Stokes, William L.** Relation of fault trends and mineralization, eastern Great Basin [abs.]: Mining Eng., v. 18, no. 12, p. 46, 1966.

9360 **Stovall, J. Willis; Price, Llewellyn I.; Romer, Alfred Sherwood.** The postcranial skeleton of the giant Permian pelycosaur *Cotylorhynchus romeri*: Harvard Univ. Mus. Comp. Zoology Bull., v. 135, no. 1, p. 1–30, illus., 1966.

In 1937, fragmentary remains of a gigantic new pelycosaur were found in the Permian Hennessy Formation of Oklahoma. Subsequently, many additional specimens were found, and it was planned that this material would be described in a paper by Stovall and Price. Since Dr. Stovall has died and Mr. Price is in Brazil, Dr. Romer is publishing this account, utilizing Price's notes and figures, and observations of the material prepared by Dr. Stovall. Reptilian remains in the Hennessy shales of the Norman area pertain almost entirely to *Cotylorhynchus*, and they are found articulated and right side up. Dr. Romer favors the interpretation that the animals were bogged down. Detailed bone-by-bone descriptions and illustrations are given.—E.S.L.

9006 **Stover, Lewis E.; Elsik, William C.; Fairchild, William W.** New genera and species of early Tertiary palynomorphs from Gulf Coast: Kansas Univ. Paleont. Contr.—Paper 5, p. 1–11, illus., 1966.

Ten new genera and 13 new species of Paleocene and Eocene pollen and spores belonging to an equal number of genera are described and illustrated. The specimens were found in palynomorph assemblages recovered from samples collected in Texas, Louisiana and Alabama.—Authors' abstract

9248 **Stow, Stephen Harrington.** The distribution of elements among the coexisting phases of the pre-Cambrian meta-sediments of west Texas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1195B, 1966.

Strasheim, A. *See* deVilliers, Daphne B. 9286

9192 **Summers, W. K.** Distribution and occurrence of New Mexico's thermal waters—A statistical summary [abs.], *in* Guidebook of Taos-Raton-Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 122, 1966.

8969 **Swanson, Donald A.** Tieton volcano, a Miocene eruptive center in the Southern Cascade Mountains, Washington: Geol. Soc. America Bull., v. 77, no. 11, p. 1293–1314, illus., tables, geol. map, 1966.

Tieton Volcano is formed of more than 5,000 feet of blocky andesite flows, fine-grained bedded tuffs, and chaotic breccias. Intruding these rocks are more than 200 dikes, which form the southern half of a radial swarm that centers on the volcano. The dikes and lava flows are orogenic andesites containing phenocrysts of plagioclase, hypersthene, and augite. The dikes are younger than the flows and contain slightly more SiO_2, Al_2O_3, and alkalis, and less CaO, MgO, and total iron, indicating weak differentiation. The reconstructed volcano had a basal diameter of at least 6.5 mi, and probably towered 8,000–10,000 feet above its base before erosion and partial inundation by the Yakima Basalt.—H.C.W.

9024 **Swift, Charles Moore, Jr.** Geology of the southeast portion of the Averill quadrangle, New Hampshire: Concord, N. H., New Hampshire Dept. Resources and Econ. Devel., 19 p., illus., table, geol. map, 1966.

Metamorphic rocks of the Lower Devonian(?) Gile Mountain Formation, trending northeast across the area, have been intruded by diorite, syenite, quartz syenite, and Conway granite of the Triassic White Mountain Plutonic–Volcanic Series. The southern tip of Monadnock stock and the western part of Stratford stock are exposed in the mapped area. Petrographic study suggests that the diorite, syenite, and quartz syenite of Stratford stock originated by differentiation from a single parent magma. Gravitative settling was the predominant mechanism, but gaseous transfer of alkalis to the upper part of the magma chamber was important also. The Conway granite, on the other hand, although derived from the same parent magma as the others, was partly formed and extensively modified by abyssal assimilation. Water expelled from the Conway granite during crystallization has extensively altered the older diorite.—E.S.L.

9247 **Symons, David Thorburn Arthur.** Paleomagnetic studies of Lake Superior iron ore deposits [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1195B, 1966.

9325 **Takin, Manoutchehr; Talwani, Manik.** Rapid computation of the gravitation attraction of topography on a spherical Earth: Geophys. Prosp. [Netherlands], v. 14, no. 2, p. 119–142, illus., tables, 1966.

A new method of gravity reduction suitable for computer use is described, which is based on the formula for the gravitational attraction of a frustum of a cone. The method is compatible with conventional zone chart methods. Several areas are computed as examples (Caryn Seamount, an area in northwestern South America, an area near Mauritius, and the Puerto Rico Trench), and results are compared with those obtained by other methods. The effects of sphericity and three dimensionality and assumptions involved in extending the models to infinity are also discussed.—D.B.V.

9110 **Talwani, M.; LePichon, X.; Heirtzler, J. R.** Patterns of magnetic anomalies over the Mid-Oceanic Ridge [summ.], *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-14, p. 345–348, with discussion [1966].

This is a summary of the paper published in full in Science, v. 150, no. 3700, p. 1109–1115, 1965 (see Abs. North American Geology, April 1966).—E.S.L.

9127 **Talwani, Manik; Ewing, Maurice.** A continuous gravity profile over the Sigsbee Knolls: Jour. Geophys. Research, v. 71, no. 18, p. 4434–4438, illus., 1966.

Gravity measurements on a traverse over three Sigsbee knolls in the Gulf of Mexico yield small negative anomalies of about 2 mgal. The density required, in a body of the size and shape found for the emerged and submerged bodies, is nearly 2.15 g per cm^3. It is concluded that the knolls and domes are diapiric masses of low-density sediment, as suggested by the fact that no knoll rises very high above the sea floor.—D.B.V.

Talwani, Manik. *See* Takin, Manoutchehr. 9325

9042 **Tarr, Russell S.** Relation of buried Tishomingo uplift to Ardmore basin and Ouachita Mountains, southeastern Oklahoma—Discussion [of paper by B. H. Harlton, 1966]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 7, p. 1518, 1966.

If the faults of the Ouachitas are vertical or nearly so, Tishomingo anticline would be chopped off abruptly where the Ouachita faults cross it. If faults of Ouachitas are almost horizontal and join in a sole fault, the northwestward-moving Ouachitas would have overridden the Tishomingo anticline and the pre-Cretaceous erosion would have left outcrops resembling the present subcrop beneath the Cretaceous cover. Overthrusting of substantial magnitude seems necessary to explain the present proximity of beds of the same age but of different physical characteristics (See Harlton, ibid., v. 50, no. 7, p. 1365–1374, 1966).—M.W.G.

8998 **Taylor, F. C.; Schiller, E. A.** Metamorphism of the Meguma group of Nova Scotia: Canadian Jour. Earth Sci., v. 3, no. 7, p. 959–974, illus., 1966.

The Meguma group of sediments, Early Ordovician or older, has undergone regional and contact metamorphism which have resulted in greenschist and almandine-amphibolite facies. Later intrusion of granitic rocks has resulted in gold-quartz veins in the greenschist zone.—M.S.T.

9019 **Thomas, Chester E., Jr.; Randall, Allan D.; Thomas, Mendall P.** Hydrogeologic data in the Quinebaug River basin, Connecticut: Connecticut Water Resources Bull. 9, 84 p., illus., tables, 1966.

The Quinebaug River basin occupies about 425 sq mi in the northeastern part of Connecticut. The data presented in this report serve to document and supplement an earlier report by A. D. Randall (ibid., Bull. 8, 1966) evaluating water resources of the basin and should be useful in planning the development of water resources at specific localities. Tables show records and logs of wells and test borings, records of springs, pumping tests, chemical analyses of water from several sources, spectrographic analyses of water from streams, and the like.—M.C.M.

9334 **Thomas, F. H.** Subsidence of peat and muck soils in Florida and other parts of the United States—A review: Soil and Crop Sci. Soc. Florida Proc. 1965, v. 25, p. 153–160, illus., 1966.

Subsidence of organic soils begins when drainage occurs. Chemical and biological oxidation, shrinkage, compaction, burning, and erosion all contribute to this loss of the soil mass. The rate at which subsidence occurs is directly proportional to the depth of the water table. However, the greatest rate occurs the first few years after drainage. All peat lands will continue to subside as long as they are drained. Cover crops may control wind erosion, but no means of stopping subsidence has been found except continuous flooding.—*from* Author's summary

Thomas, Mendall P. *See* Thomas, Chester E., Jr. 9019

Thomas, Rex D. *See* Champlin, Jerry B. F. 9115

9108 **Thompson, George A.** The rift system of the western United States, *in* The world rift system—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-14, p. 280–290, illus. [1966].

The extent of Cenozoic normal faulting, characterized by tensional strain, best defines the rift system of western United States. Conclusions drawn are: (1) Near the margins of the system there is an overlap in types of deformation; (2) present seismic activity does not coincide with the rift zone; (3) the region of anomalously thin crust and anomalous upper mantle correlates better with the rise than with the rift; (4) volcanism and heat flow show closest correlation with the rift system; more heat flow and magnetic measurements are needed; (5) individual rifts may be underlain by igneous intrusions; (6) volume changes at the moment of large earthquakes are consistent with the elastic rebound theory.—*from* Author's abstract

Thomsen, B. W. *See* Brown, S. G. 8980

9066 **Thorsen, G. W.** Lime Mountain deposit, *in* Limestone resources of western Washington: Washington Div. Mines and Geology Bull. 52, p. 341–343, illus., 1966.

The limestone on Lime Mountain in Snohomish County is relatively coarse-grained and of fair quality. The deposit is, however, cut by aplite dikes which will make it difficult to produce good quality rock in large quantities.—E.S.L.

9167 **Thorsen, G. W.** Titanium, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 148–149, 1966.

Residual deposits, containing significant amounts of titanium in Spokane, Cowlitz, and Wahkiakum Counties, are considered to be derived by the chemical decomposition of basalt rock and have been investigated as possible sources of aluminum. The titanium is present as very fine-grained ilmenite or titaniferous magnetite, and might be considered as a potential reserve as a by-product of aluminum production. Titanium also occurs in both modern and ancient beach sands of southwestern Washington, largely in the form of fine-grained (80 to 200 mesh) titaniferous magnetite and hematite, ilmenite, and intergrowths of these minerals. There has been no commercial production.—W.L.G.

9270 **Thorsen, G. W.** High-alumina refractory materials, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 219–224, illus., 1966.

"There has been no production from Washington of any of the five high-alumina refractory minerals. They are known to occur in numerous localities in northeastern Washington and in a few places in the eastern Cascades. Little information is available on other possible occurrences in the extensive metamorphic terrain of the Cascade Mountains. The known occurrences of possible commercial interest are listed" and described briefly.—W.L.G.

9198 **Tidwell, William D.** Cretaceous paleobotany of eastern Utah and western Colorado, *in* Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, p. 87–95, illus., 1966.

Fossil plant remains of Cretaceous age appear to be relatively abundant in Utah coal fields, but no comprehensive paleobotanical studies have been published. Some of the early geological studies attempted to use fossil plants associated with coals to indicate age of beds, and included floral lists without taxonomic descriptions or discussions. Lesquereux (1873) determined age of western "lignite" beds as Eocene, including the Fort Union Formation of Utah. Newberry (1874) corrected this, leaving the Fort Union in the Tertiary and placing the rest in the Cretaceous. He cited the difference between these and the European Eocene flora which Lesquereux had compared, associated Cretaceous mollusks, and dinosaur remains described by Meek, Cope, and Marsh. Specimens collected since then are briefly summarized.—G.D.C.

Tilstra, J. R. *See* Hopkins, W. B. 9437

9399 **Tisdale, E. W.; Fosberg, M. A.; Poulton, C. E** Vegetation and soil development on a recently glaciated area near Mount Robson, British Columbia: Ecology, v. 47, no. 4, p. 517–523, illus., tables, 1966.

Rapid retreat of the Robson Glacier since 1783 has produced a series of moraines well suited for study of vegetation and soil development. The terminal and five recessional moraines ranging in age from 180 to 50 years were studied in August 1963 in continuation of earlier work by W. S. Cooper. The vegetation of the two oldest moraines bears a superficial resemblance to the mature forest of the region, but differs greatly in floristic composition and structure. Soil formation ranges from virtually none on the youngest moraine to a rudimentary podsolic B horizon on

the oldest recessional moraine. Accumulation of soil nitrogen appears to be slow, despite root nodules on species of *Dryas* and *Hedysarum*.—*from* Authors' abstract

8901 **Todd, Thomas W.** Darton Ridge, Pennsylvanian feature of Wyoming shelf: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2519–2546, illus., table, 1966.

In Wyoming, Upper Pennsylvanian–Lower Permian Tensleep Sandstone was deposited as a thin blanket sand on a shelf extending southwest from a Pennsylvanian continent. Contour maps of Tensleep thickness, texture, and composition variables show thinner, even bedded, unimodal deposits in north central Wyoming surrounded by thicker, cross laminated, bimodal deposits, outlining an elongate, southwest-trending bathymetric prominence (the Darton Ridge); shallow-water conditions prevailed over this ridge during Pennsylvanian time. Sampling techniques, petrographic data, and statistical tests applied are discussed in detail.—B.H.K.

9064 **Toewe, E. Clayton.** Geology of the Leesburg quadrangle, Virginia: Virginia Div. Mineral Resources Rept. Inv. 11, 52 p., illus., tables, geol. map, 1966.

In this quadrangle in Loudon County, Cambrian or Precambrian chlorite schists of the Catoctin Formation are overlain by banded quartzites of the Weverton Formation with suggested local disconformity. Triassic sedimentary and pyroclastic rocks, basalts and diabases are separated from the older formations by the normal high-angle, eastward dipping Bull Run fault. Truncation can be explained by a combination of fan-like sedimentation and post-Triassic faulting. Three periods of Triassic or post-Triassic igneous activity are recognized by a sequence of interbedded basalts and pyroclastic rocks, younger vesicular basalt flow, and an intruding diabase. The diabase is crushed for road material, other rock types could be so used, limestone has been used for lime and agricultural stone, and Triassic clay and shale have potential value.—G.D.C.

8900 **Tohill, Bruce; Picard, M. Dane.** Stratigraphy and petrology of Crow Mountain Sandstone Member (Triassic), Chugwater Formation, northwestern Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2547–2565, illus., tables, 1966.

The boundaries of the Crow Mountain Sandstone Member are redefined and the member is divided into a basal sandstone unit, and an upper sandstone and siltstone unit. The sandstone and siltstone are arkose and subarkose. The Crow Mountain is interpreted to have been deposited during a westward regression of the sea. The principal environments of deposition were (1) shallow marine, with moderate to strong currents during deposition of the basal sandstone unit; (2) tidal flat, with weak currents during deposition of most of the upper sandstone and siltstone unit; and (3) beach, during deposition of the uppermost part of the upper unit.—W.C.C.

9091 **Tomkins, J. Q.** Polygonal sandstone features in Boundary Butte anticline area, San Juan County, Utah—Reply [to discussion of 1965 paper by J. T. Neal, 1966]: Geol. Soc. America Bull., v. 77, no. 11, p. 1331–1332, illus., 1966.

The mud-crack casts observed in the Carmel Formation form irregular random orthogonal polygons. The large mud cracks developed on Kennecott Copper Corporation's tailings pond follow a regular random orthogonal pattern. Size of mud cracks developed is related to container size and to thickness and homogeneity of sediment. Undefined boundary factors may affect the dessication patterns of playas.—J.P.A.

Tooker, E. W. *See* Roberts, Ralph J. 9045

9331 **Toulmin, Lyman D.** (and others). Summary of the Tertiary stratigraphy of south-central and southwest Alabama, *in* Facies changes in the Alabama Tertiary—Alabama Geol. Soc., 4th Ann. Field Trip 1966, Guidebook: University, Ala., Alabama Geol. Soc., p. 3–10, illus., 1966.

In Alabama the Tertiary formations consist predominantly of marine clastics, transitional in character between the clastic and nonmarine formations of Mississippi and the carbonate rocks of the Florida peninsula. In Alabama the Paleocene, upper

Eocene, and Oligocene formations grade into limestone, one of the lower Eocene formations grades downdip in the subsurface into limestone, and the middle Eocene formations become increasingly calcareous eastward, as shown on a chart. The various formations in these series are described briefly. The summary is compiled from published work of members of the committee and from field mapping data in a cooperative project.—G.D.C.

9470 **Tovell, Walter M.; Deane, Roger E.** Ancestral Lake Superior shorelines, Montreal River Harbour area, Ontario [with French summ.]: Geol. Assoc. Canada Proc., v. 17, p. 53–63, illus., 1966.

Ancestral beaches, associated with the late stages in the development of Lake Superior, occur in the Montreal River Harbour area, 75 miles north of Sault Ste. Marie. The exposures are exceptional in that they display a fine array of off-shore bars, and in one of the two localities surveyed the sequence of changes in water levels can be followed almost continuously for over 200 feet. In all, three water planes have been identified, but only the Nipissing has been named and correlated; insufficient data are available for the Superior Basin as a whole to warrant naming the other two. A particular feature of the area is the presence of a large gravel bar, interpreted as having been formed during a rising stage of the ancestral lake sequences.—Authors' abstract

Treichel, A. *See* Halstead, E. C. 8997

9016 **Trylich, C.; Bayrock, L. A.** *Bison occidentalis* Lucas found at Taber, Alberta, Canada: Canadian Jour. Earth Sci., v. 3, no. 7, p. 987–995, illus., table, 1966.

An articulated incomplete skeleton of a mature male *Bison occidentalis* Lucas was found in alluvial sand on the uppermost terrace of the Oldman River near Taber, Alberta. Description of the bones and some comparison with ox and horse are made. Two radiocarbon ages of 10,500 and 11,000 years and invertebrate fossil and pollen analyses show that at this time the area was free of ice and that parkland vegetation was well established in southern Alberta. The pebble chopper found with the skeleton points to human occupation at that time.—Authors' abstract

9121 **Tuan, Yi-Fu.** New Mexican gullies—A critical review and some recent observations: Assoc. Am. Geographers Annals, v. 56, no. 4, p. 573–597, illus., 1966.

The gully (arroyo) in the American Southwest has attracted scientific attention for more than 60 years. First, gullies tended to be viewed as the result of changes in vegetation cover brought about by man and his live-stock. Later, discovery of prehistoric gullies led to the elaboration of a widely accepted model relating climatic events to erosion-deposition. Recently the study of the pollen record has inspired a new model different in important respects. Examination of New Mexican gullies suggests that the new model has certain advantages, but that our knowledge is still extremely hypothetical. An attempt is made to compare local environments of gullies in New Mexico, and in the case of the Rio Chaco and Rio Puerco, to document the history of their gullies in detail.—*from* Author's abstract

Tuttle, O. F. *See* Luth, W. C. 9078

9443 **Ulrich, Johannes.** Die Mittelozeanischen Rücken—Neue Erkenntnisse über die geophysikalischen Vorgänge im Bereich des grössten Gebirgssystems der Erde [with English summ.]: Geog. Rundschau, v. 18, no. 11, p. 407–418, illus., 1966.

Modern geological research is increasingly centered on the ocean bottom itself, and on the geophysical character of the Earth's crust and mantle beneath its ridges. Provisional conclusions on the dynamic origin show new aspects of problems related to the continental drift theory, e.g. relative age and direction of main faults, subcrustal heat flow intensity, and volcanic activity in more recent oceanic ridges in contrast to concentration of volcanoes on older ones. Intense flow of energy from the Earth's interior has caused instability in certain areas of the crust leading to tensions, fractures, and fault dislocations, and resulting in development of the

mid-oceanic ridge/rift system as a world-wide continuous tectonic element.—G.D.C.

9401 **U.S. Atomic Energy Commission.** Nuclear science abstracts, V. 20, Nos. 1–24, Abstracts 1–47096: Oak Ridge, Tenn., U.S. Atomic Energy Comm., Div. Tech. Inf. Ext., 5748 p., 1966.

U.S. Bureau of Reclamation. *See* U.S. Geological Survey. 9258

9258 **U.S. Geological Survey; Washington Div. Mines and Geology; U.S. Bureau of Reclamation.** (and others). Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, 436 p., illus., tables, geol. map, 1966.

In introductory chapters the geology of Washington is summarized, and a brief résumé is given of the mineral industry and its relative importance in the economy of the State. In succeeding chapters all mineral resources known to occur in the State in commercial or near-commercial quantities are discussed. The second part of report deals with the State's water resources, the quantity, quality, and distribution, and their use for municipal water supply. In a separate chapter, developed and potential resources of hydroelectric power are discussed; and a final chapter is on water resource development exclusive of hydroelectric power and municipal water supply. Individual papers are cited separately.—W.L.G.

9349 **Vaasjoki, O.** Mackinawiitin termisistä ominaisuuksista—An analytical note [reply (in English) to discussion of 1966 paper by A. H. Clark]: Geologi, v. 18, no. 8–9, p. 124, table, 1966.

Analytical data here given for mackinawite from Hitura, Finland, show a nickel content of 11 weight percent; pure pentlandite contains 34.77 percent Ni. These data, as well as results of the heating experiments on the Hitura mackinawite, seem to be in accordance with Clark's (ibid., v. 18, no. 7, p. 97–98, 1966) concept that the upper stability limit of mackinawite is reached at higher temperatures with increasing solid solution of Ni and Co.—V.M.J.

Valentine, Wilbur G. *See* Donn, William L. 9433

9267 **VanAlstine, R. E.** Fluorspar, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 199–204, illus., table, 1966.

The fluorite deposits of Washington occur mainly in Paleozoic limestone and argillite, Mesozoic and Tertiary granitic intrusives, and Tertiary volcanic rocks. Most deposits are in veins but pegmatite, lens, replacement, and pipe-like deposits are known. Eighteen fluorite localities in Washington, including mineralogic occurrences that represent types of deposits productive in other States, are shown on a figure and described briefly in a table.—W.L.G.

VanAndel, Tjeerd H. *See* Melson, William G. 9205

vanWamelen, Diana. *See* deVilliers, Daphne B. 9286

9392 **Verner, William J.; Shurtz, Robert F.** For mine evaluation—A fresh model: Mining Eng., v. 18, no. 11, p. 65–71, illus., tables, 1966.

An economic analysis of a mineral property must answer the following three basic questions: (1) How much can the company afford to pay, (2) at what rate should the property be mined, and (3) what will be the return on the investment. An economic evaluation method is proposed which is valid under varying conditions of ore grade and tonnage reserves. The method is illustrated by an actual economic analysis of an existing nickel-copper deposit.—F.C.C.

9156 **Vhay, J. S.** Bismuth, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 63–66, table, 1966.

"Deposits in Washington in which bismuth minerals have been identified or in which bismuth has been reported include: two pegmatites; one contact metamorphic deposit; six probably high-temperature hydrothermal deposits, four of which are valued mostly for their tungsten content; and nine of moderate temperature hydrothermal deposits valued for their content of gold, silver, lead, or copper, or combinations of these metals. Of these last, seven are vein deposits and two are disseminated deposits. The names, locations, and brief descriptions are listed in a table."—W.L.G.

9157 **Vhay, J. S.** Chromium, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 66–71, illus., table, 1966.

Very little chromite has been produced in Washington. The deposits that have had at least some production are described and the locations of the deposits are given. "Only two areas appear to have possibilities as future sources of chromite in the State: the Twin Sisters area of primary chromite concentrations, and the Cle Elum–Peshastin band of "fossil laterite." The latter is of interest only if a usable type of steel can be produced that contains chromium, nickel, and cobalt in about the same proportions as those in which these elements occur on the average in the deposits."—W.L.G.

9158 **Vhay, J. S.; Weissenborn, A. E.** Copper, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 71–81, illus., table, 1966.

The principal copper producing districts in Washington are listed and described briefly in a table. Although Washington is now producing no copper, numerous and widespread occurrences in the Cascade Mountains and the Okanogan Highlands, and the recent development of important copper properties in adjacent parts of British Columbia, indicate that the potential of this part of the State for producing copper should not be ignored.—W.L.G.

9163 **Vhay, J. S.** Nickel and cobalt, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 116–125, illus., table, 1966.

"The nickel occurrences in Washington are of two general types—those occurring in, derived from, or closely associated with ultramafic bodies; and those where nickel is associated with sulfides of copper, lead, zinc, or other metals in veins or disseminated deposits in many different types of host rocks. Cobalt occurs with copper and other metallic sulfides and sulfarsenides, in veins or disseminated deposits; a small amount is everywhere present with the nickel in ultramafic rocks." A list of properties where nickel or cobalt occur (excepting those occurring in silica–carbonate rock, derived from serpentine, and those occurring in "fossil laterite") are given in a table.—W.L.G.

9215 **Vhay, J. S.** Olivine, serpentine, and asbestos, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 231–235, illus., table, 1966.

"The present annual production of olivine in the State of Washington is approximately 25,000 tons. Nearly all this production has been from the Twin Sisters dunite mass in Skagit and Whatcom Counties. The Twin Sisters dunite mass is the largest known in the United States and is unusual, and valuable, in that the olivine in it is almost completely unaltered. Only around its edges is the olivine serpentinized. This is true of most of the younger (middle Tertiary?) masses of dunite in the State; the older ultramafic rocks are now mostly serpentine." Washington has produced no chrysotile asbestos and only a small amount of amphibole-type asbestos. Known occurrences are shown on a table and plotted on a map, which also shows the large areas of ultramafic rocks. A few of the past producers are also included.—W.L.G.

Vhay, J. S. *See* Weissenborn, A. E. 9276

9278 **Vhay, J. S.** Talc and soapstone, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 273–274, 1966.

Talc and soapstone deposits that have had production during the last 10 years are limited to Skagit County, mostly near Marblemount, where they occur in a complex of greenschist, derived from mafic volcanic rocks, and of serpentine. Both the schist and the serpentine have been metamorphosed by intrusive granodiorite of pre Carboniferous age. Both ground talc and dimension soapstone are produced from these deposits. Some of the soapstone is of high enough quality to be usable as "lava talc."—W.L.G.

Vian, Richard W. *See* Heinrich, E. William. 8993

9103 **Vokes, Emily H.** A new species of *Chicoreus* (Mollusca:Gastropoda) from the Miocene of southern Florida: Tulane Studies Geology, v. 5, no. 1, p. 36–37, illus., 1966.

Chicoreus shirleyae, described herein from Pinecrest Beds along the Kissimmee River, is presently known from a small area north of Lake Okeechobee. It occurs with the common and widespread Miocene and Pliocene species *C. floridanus*, and represents an offshoot which failed to survive. It is distinguished by its narrow shape, more deeply indented suture, lack of pronounced varical swelling, and its conspicuous, deeply incised spiral ornamentation.—G.D.C.

9105 **Vokes, Emily H.** The genus *Vasum* (Mollusca:Gastropoda) in the New World: Tulane Studies Geology, v. 5, no. 1, p. 1–36, illus., 1966.

This genus originated in the New World with the late Eocene species *V. humerosum* Vaughan; its history there is well documented but the fossil record in the Old World is poorly known, no species since mid-Miocene time having been reported. All of the New World species, 19 fossil and 6 Recent, are treated systematically, including three new herein described from the Miocene of Florida—*V. jacksonense* from the Choctawhatchee Formation, *V. olssoni* from the Pinecrest Beds, and *V. chipolense* from the Chipola Formation.—G.D.C.

9104 **Vokes, Harold E.** A new species of the bivalve genus *Nucinella* from the Eocene of Louisiana: Tulane Studies Geology, v. 5, no. 1, p. 38–40, illus., 1966.

In a slump block of Cook Mountain Formation, on the east bank of the Sabine River near Columbus, a minute left valve of *Nucinella* was found, the first of this genus reported from older Tertiary deposits of the Atlantic and Gulf Coastal Plain. It has been reported from the upper Miocene to Recent of Florida. Despite a long geologic range (Lower Jurassic of Europe to Recent) and wide geographic range of the genus, specimens are rare. The small size of *N. alleni*, described herein, distinguishes it from other known North American Tertiary and Recent species cited from Florida and the upper Eocene of Oregon, which also differ in details of the cardinal area of the hinge structure.—G.D.C.

Waddell, Kidd M. *See* Mundorff, James C. 9441

9151 **Wagner, H. C.; Snavely, P. D., Jr.** Geology—Western Washington, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 37–46, illus., 1966.

"Western Washington includes an area of approximately 20,000 sq mi, a region of exceedingly variable physiography and greatly divergent rock types. The foothills of the western Cascade Range, in particular those parts underlain by Tertiary rocks, are included in this description of western Washington geology. The bedrock exposed in western Washington is chiefly of Tertiary age and is part of a eugeosynclinal accumulation of sedimentary and volcanic rocks, predominantly of marine origin." The pre-Tertiary, Tertiary, and post-Tertiary rocks of this area are discussed.—W.L.G.

9280 **Wagner, H. C.** Petroleum and natural gas, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 287–296, 1966.

"Exploratory test wells in the State of Washington have discovered evidence of petroleum and natural gas in more than 100 wells, but only minor production of these commodities have been obtained and neither is yet economically important. Solid hydrocarbons have been found only in small occurrences, and no deposits of rocks classifiable as oil shale are known in the State."—W.L.G.

9475 **Waller, Roger M.** Effects of the March 1964 Alaska earthquake on the hydrology of the Anchorage area: U.S. Geol. Survey Prof. Paper 544-B, p. B1–B18, illus., 1966.

The hydrologic system at Anchorage was greatly affected by the 1964 earthquake. Temporary effects included seiche action on lakes, fluctuations in ground-water levels, snowslides, and increased or decreased stream discharge. Water supplies were temporarily disrupted by snowslides, damaged wells, or by sanding of wells. Post-quake measurements show that artesian pressures were generally lowered. This "permanent" lowering is attributed to changes in discharge zones offshore or to a change in aquifer permeability. Temporary decrease in stream discharge was due to increased recharge to aquifers. Salt-water encroachment on Fire Island seems to have increased, and the lowered artesian level and the 2.7-ft lowering of land level may permit further encroachment. Increased pore pressure in silt and sand lenses in the Bootlegger Cove Clay contributed to the diastrous landslides.—R.M.W.

Walsh, George M. *See* Krause, Dale C. 9059

Walters, R. L. *See* Dellwig, L. F. 9367

Wanek, A. A. *See* Johnson, R. B. 9212

Wanless, R. K. *See* McCartney, W. D. 9405

9418 **Ward, Stanley.** The sun and ore-finding [abs.]: Mining Eng., v. 18, no. 12, p. 44, 1966.

Washington Div. Mines and Geology. *See* U.S. Geological Survey. 9258

9057 **Watson, R. A.** Central Kentucky karst hydrology, *in* Limestone hydrology—A symposium with discussion: Natl. Speleol. Soc. Bull., v. 28, no. 3, p. 159–166, 1966.

Three general aspects of underground flow in central Kentucky are summarized: (1) the underground drainage pattern as a set of systems tributary to the Green River, (2) the solutional activity of the underground water, and (3) the underground drainage as a set of transportation systems for mechanical sediment. Conclusions, based on ten years of study, are: that the active underground drainage systems are more complex than their known parts indicate, with major water channels probably existing beneath the present-day base level; that a major amount of solutional activity occurs in the surficial mantle and on the bedrock surface causing a general lowering of the land surface; and that most of the sediment in the cave passages is provided by flow which moves from the surface through the cave systems to the Green River.—E.S.L.

Weaver, W. G., Jr. *See* Rose, Francis L. 9102

8988 **Weeks, Lewis G.** Estimation of petroleum resources—Commentary [on discussion by A. R. Martinez, 1966]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 9, p. 2008–2010, 1966.

The primary purpose of preparing comparative ultimate resource estimates is to achieve efficiency in expenditure of exploration funds, whereas the purpose of calculating proved reserves is to prepare an inventory of readily available resources. All estimates of resources are but order-of-magnitude figures, and to be of any

value they must be based on the only possibly acceptable parameters for making such estimates, which are geological.—M.W.G.

9352 **Wegmann, E.** Cinq panoramas des fjords du Groenland nord-oriental: Soc. Neuchateloise Géographie Bull., v. 53, no. 2, new ser., no. 14, p. 129–139, illus., 1965 [1966].

The history of fjord genesis is reviewed. Two banks of Forsbladsfjord and three of Kempefjord carved in upper Precambrian and lower Paleozoic strata are sketched and described in detail. The upper parts of the fjords are still filled with ice, but raised marine terraces are found in the lower part. Glacial features and types of glaciers present are reviewed. The facade of the banks is broken only by entering valleys, with lesser breaks filled with steeply sloping glaciers. Solifluction occurs where talus or morainic material accumulates on slopes, and sometimes layers are superimposed, separated by vegetation. Glacier-dammed lakes, when released, erode and transport more in a day than the rivers could in years. Sediments along the banks are a mixture of blocks and fine material, slipping toward the foot of the submarine slope.—E.S.L.

9246 **Weiblen, Paul Willard.** A funnel-shaped, gabbro-troctolite intrusion in the Duluth complex, Lake County, Minnesota [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1196B, 1966.

8905 **Weichbrodt, L. E.** Harold Tague Weichbrodt (1921–1966): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 12, p. 2623, portrait, 1966.

9453 **Weidick, Anker.** Jakobshavns isbrae i fortid og nutid: Gronland 1966, no. 11, p. 361–386, illus., table, 1966.

Early writings and surveys of Jakobshavns Isbrae and ice inlet date back to 1747 with an expedition by P. O. Walloe; since that time methods of observations and records have been kept of the glacier's movement and ice production which averages about 16 km^3 per year. Carbon-14 dating of shells indicates that a great deal of Disko Bugt was ice free about 9,000 yr B.P. Descriptions of Jakobshavns Isbrae since that time are given; a 27-item bibliography is included.—M.C.M.

9269 **Weis, P. L.** Graphite, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 216–219, illus., 1966.

"Graphite occurs in a variety of metamorphic rocks in Washington and is probably even more widespread than is presently known. However, as far as is known, graphitic rock has been sold from only one property in the State. Valentine (1960) lists 33 occurrences, which are shown in a figure. All localities shown and descriptions provided are from Valentine (1960)."—W.L.G.

Weis, P. L. *See* Bennett, W. A. G. 9271

9147 **Weissenborn, A. E.** Geology—Introduction, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 13–15, illus., 1966.

The area under study is divided into four sections: northeastern Washington, the Columbia Basin, including the Blue Mountains; the Cascade Mountains; and western Washington. The geology of each of these sections is summarized with the intent of providing a background for the remainder of the report. Bibliographic references are given, and a highly generalized map of the geology of Washington is included.—W.L.G.

9150 **Weissenborn, A. E.; Cater, F. W.** Geology—The Cascade Mountains, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 27–37, illus., 1966.

"The Cascade Range in Washington consists of two geologically contrasting areas. South of Snoqualmie Pass, Tertiary volcanic rocks with relatively simple structures

predominate. North of the pass, most of the exposed rocks are structurally complex pre-Tertiary igneous and metamorphic rocks. To some extent, the geologic differences are reflected in the topography, the area underlain by the pre-Tertiary rocks tending to greater ruggedness and topographic variety. The northern part of the Cascade Mountains consists essentially of a core of crystalline rocks—mostly granitic rocks and metamorphosed ancient sedimentary and volcanic rocks—flanked by younger sedimentary and volcanic rocks."—W.L.G.

9152 **Weissenborn, A. E.** The mineral industry of Washington, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 47–52, illus., 1966.

Washington's mineral production ranks 35th among the States with respect to the value of its mineral output. In 1963, 81.6 percent of the value of the State's mineral production came from nonmetallic minerals and only 18.4 percent from metallic ores. In terms of total production and value of product, coal, sand and gravel, and stone are by far the most important mineral commodities produced in the State. Zinc, gold, lead, copper, uranium, and silver are the next most important commodities produced. Two figures are included giving the mineral production from 1900–63, and mineral production by commodities.—W.L.G.

Weissenborn, A. E. *See* Lesure, F. G. 9155

Weissenborn, A. E. *See* Vhay, J. S. 9158

9164 **Weissenborn, A. E.** Silver, lead, and zinc, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 125–141, illus., table, 1966.

Lead, silver, and zinc deposits are distributed widely throughout the Okanogan Highlands and the Cascade Mountains. Many of these deposits in Washington are found in or close to granitic intrusive masses. The most productive deposits for lead and zinc are in carbonate rocks in Stevens and Pend Orielle Counties, and most of the silver produced has come from deposits chiefly valuable for copper. The silver, lead, and zinc districts of Washington are listed in a table and brief descriptions are given.—W.L.G.

9260 **Weissenborn, A. E.** Uranium, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 157–166, illus., tables, 1966.

As of February 28, 1965, the total uranium produced from the State of Washington was 4.7 million pounds of U_3O_8 from 1.2 million tons of ore. The highest production of uranium came from two mines, the Midnite mine in Stevens County, and the Daybreak mine on the west slope of Mount Spokane. Numerous other occurrences have been reported, but little information is available on most of them. The better authenticated ones, together with all localities from which there has been production of uranium ore, are listed in a table.—W.L.G.

Weissenborn, A. E. *See* Bennett, W. A. G. 9271

9276 **Weissenborn, A. E.; Vhay, J. S.** Silica, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 257–265, illus., tables, 1966.

"Washington sources of industrial silica are quartz zones in pegmatites; quartzite or sandstone beds, particularly in the Cambrian Addy Quartzite in Stevens County; and, to a lesser extent, deposits of silica sand." Deposits that have produced industrial silica in recent years are listed in a table and the locations of the deposits are shown on a map. A few natural sand deposits in the State have produced high-grade silica. Further search seems justified, but the chances of a large discovery of high-purity silica do not appear as good as in the quartzites.—W.L.G.

9120 **Wertz, Jacques B.** The flood cycle of ephemeral mountain streams in the southwestern United States: Assoc. Am. Geographers Annals, v. 56, no. 4, p. 598–633, illus., 1966.

Flood cycles of an arroyo exhibit: (1) a flood stage, often turbulent and violent, and impossible to study as it occurs; (2) an immediate after-flood stage with conspicuous patterns, some of which may be observed; (3) a dry stage when some detailed mechanisms of transport patterns may be observed until the next flood. From the dry stage, aided by impressions gained during the other two, systematic inferences may be drawn concerning transport mechanisms throughout the cycle. With waning floods, heaviest load elements are dropped along the channel in a series of primary step patterns dependent on channel character, volume of flow, and flood velocity. Late water of the after-flood stage readjusts channel attitudes and resorts finer materials. As it wanes in volume, finest materials are resorted and arranged in minor forms within the channel.—*from* Author's abstract

West, Lawrence J. *See* Proctor, Richard J. 9374

West, Neil E. *See* Mitchell, John E. 9398

9003 **Westermann, G. E. G.** New occurrences of *Monotis* from Canada (Triassic Pelecypoda): Canadian Jour. Earth Sci., v. 3, no. 7, p. 975–986, illus., table, 1966.

Monotis typica (Kipar.), *M.* cf. *M. haueri* Kittl, and *M. daonellaeformis* Kipar. are for the first time described from Canada. *M. typica* occurs in the Paradont formation of British Columbia, doubtfully in Lower Norian, and probably throughout Middle Norian. Associated with upper Middle Norian *Himavatites columbianus* ammonoid assemblage of the same area is *M. obtusicostata* sp. nov.; it occurs with the first sparse *M. pinensis* West, and the last *Halobia M. pinensis* flourishes above this assemblage. *M.* cf. *M. haueri* occurs in the Upper Norian 'formation D' of the Lewes River group in southern Yukon. *M.* cf. *M. daonellaeformis* is described from Middle Norian of Axel Heiberg Island.—*from* Author's abstract

9449 **Weyl, Richard.** Korallenriffe, Riffkalke und Nehrungen an den Küsten Jamaicas: Natur u. Mus., v. 96, no. 8, p. 301–310, illus., 1966.

The Jamaica coast affords study of the growth, ecology, and rock formation of living coral reefs, reef limestone, and spits. A table gives the arrangement of faunal zones, with width and depth, in several reef regions; these are described and percentages of species listed. The Quaternary shorelines have sharp edges and terraces, often surf-worn. Height of cliffs, some over 300 m, and number of terraces vary, indicating irregular changes in level. Where sand and gravels from older inland sources are abundant there are no reefs, such as the river mouth at Kingston, where a spit separates a good harbor from the open-sea, reefs and cays. Spit and reef development during glacial and postglacial times was complicated by sea-level fluctuations, karst formation, stream deposition, and sediment transport.—G.D.C.

8978 **Whitcomb, Harold A.; Cummings, T. Ray; McCullough, Richard A.** Ground-water resources and geology of northern and central Johnson County, Wyoming: U.S. Geol. Survey Water-Supply Paper 1806, 99 p., illus., tables, geol. map, 1966.

Sedimentary rocks exposed in northern and central Johnson County range in age from Cambrian to Recent with average total thickness of 16,000 feet. Precambrian igneous and metamorphic rocks crop out in the Bighorn Mts.; pre-Tertiary rocks lie at great depth in the Powder River basin; the rest of the area is underlain by a thick sequence of Paleocene and Eocene interbedded sandstone, siltstone, and shale. The Wasatch Formation is the principal aquifer; other sources are: alluvial deposits in the Powder River drainage basin; Precambrian rocks, Tensleep Sandstone, glacial and alluvial deposits (western part), Parkman Sandstone and Fort Union Formation (southwestern).—*from* Authors' abstract

White, D. E. *See* Alexander, W. H., Jr. 9336

9338 **Whitten, E. H. T.** Quantitative models in the economic evaluation of rock units—Illustrated with the Donegal granite and the gold-bearing Witwatersrand conglomerates: Inst. Mining and Metallurgy Trans., Sec. B, v. 75, Bull. 717, p. B181–B198, illus., 1966.

The value of computer-oriented techniques in obtaining maximum information from expensive data relating to mineral exploration problems is discussed. The necessity for adequate knowledge of the representativity of the data and for consideration of the data in the light of the factors controlling their distribution is emphasized. The application of trend surface analysis to providing accurate, precise and reproducible information from apparently complex data is illustrated with specific reference to the 'older granite' of Donegal [Ireland] and some gold assay data for Virginia mine, South Africa.—Author's abstract

9454 **Wickman, Frans E.** Repose period patterns of volcanoes, [Pt.] 4, Eruption histories of some selected volcanoes: Arkiv Mineralogi och Geologi, v. 4, no. 4, p. 337–350, illus., 1966.

The eruption records of the following 10 volcanoes are studied: Etna and Vesuvius, Italy; Hekla, Iceland; Karymsky, Kliuchevskoi and Mutnovsky, Kamchatka; Kilauea and Mauna Loa, Hawaii; Mayón, Philippines; and Popocatépetl, Mexico. From the duration of their reposes the survival number function and the equivalent age-specific eruption rate curve have been constructed according to the definitions in the first paper of this series. Three volcanoes—Etna, Mauna Loa and Popocatépetl—seem to have eruption rates which are roughly constant.—Author's abstract

9308 **Williams, Charles H., Jr.** Claiborne County structural geology, *in* Claiborne County geology and mineral resources: Mississippi Geol. Econ. and Topog. Survey Bull. 107, p. 119–123, illus., 1966.

Subsurface structure of Claiborne County, Miss., is illustrated by contoured maps on the top of the Lower Cretaceous Wilcox and Glendon Formations. Claiborne County is situated on the west flank of the Mississippi Embayment, and structural dip is to the south and southeast. Two ridges with low relief and five salt piercements are shown. All features except the salt domes existed prior to Lower Tuscaloosa deposition.—E.S.L.

9465 **Williams, Frank E.** Fluorspar deposits of New Mexico: U.S. Bur. Mines Inf. Circ. 8307, 143 p., illus., tables, 1966.

Productive fluorspar deposits among 201 occurrences of fluorite mentioned have been the source of nearly 641,000 tons of crude ore and hand-sorted material produced through 1962. A summary description is given of the location, mineral components, extent, and general form of about 85 percent of the occurrences.—A.P.B.

Williams, H. *See* McCartney, W. D. 9405

9402 **Williams, Harold.** Geology, Chisel Lake, Manitoba: Canada Geol. Survey Map 1180A (also in Mem. 342), scale 1:12,000, 1966.

9406 **Williams, Harold.** Geology and mineral deposits of the Chisel Lake map-area, Manitoba [with French, German, and Russian abs.]: Canada Geol. Survey Mem. 342, 38 p., illus., tables, geol. map, 1966.

The map-area comprises 10 sq mi within the Churchill province of the Precambrian Shield. Petrology of the eight subdivisions of the Amisk Group is given and chemical analyses tabulated. Williams considers the quartz-eye gneiss to have been a crystal tuff originally, as field relationships, petrographic studies, and chemical and micrometric analyses combine to indicate a pyroclastic origin. The differentiated basic Chisel Lake intrusion is described also. The map-area forms part of the Snow Lake mineral district now being developed for base metals. The Chisel Lake zinc-copper mine, the largest of the orebodies, is a high temperature epigenetic deposit.—E.S.L.

9062 **Williams, Roger B.** Recent marine podocopid Ostracoda of Narragansett Bay, Rhode Island: Kansas Univ. Paleont. Contr.—Paper 11, 36 p., illus., tables, 1966.

Forty-six Peterson dredge samples from Narragansett Bay, Rhode Island, have been examined for marine podocopid ostracode specimens. Estimated data on salinity, temperature, depth, and bottom sediment compiled from earlier published reports have no conclusive relationships with faunal distribution because of the possibility that they are not representative of the collecting period. Twenty-one species of ostracodes are identified and illustrated, including a new species of *Loxoconcha* and *Cytheromorpha warneri* represented by a new subspecies. The presence in Narragansett Bay of five species previously reported from North Carolina and three from Maine suggest a mixed marine fauna with representatives of both semitropical warm-water and arctic cold-water assemblages.—*from* Author's abstract

9381 **Wilson, John E.; Bohidar, Naikananda K.** Stress distribution in short columns [abs.]: Mining Eng., v. 18, no. 12, p. 48, 1966.

9332 **Winslow, John D.; Nuzman, Carl E.** Electronic simulation of ground-water hydrology in the Kansas River valley near Topeka, Kansas: Kansas Geol. Survey Spec. Distrib. Pub. 29, 24 p., illus., table, 1966.

The model of the Kansas River valley described in this report illustrates the theoretical approach, the method of construction, and the application to ground-water investigations of steady-state electrical analog models. It also permits evaluation of changes induced in the hydrologic system of an area by man. This steady-state model consists of a network of resistors mounted on a base map. The conductivity of the resistors is scaled to the spatial transmissibility of the alluvium in the valley. Analysis of equilibrium conditions in 1963, shows inflow as underflow through the aquifer was 1.6 mgd; from glacial till on the north, 2.3 mgd; infiltration from Soldier Creek, 1.2 mgd; and from precipitation, 6.8 mgd. Outflow as underflow through the aquifer was 0.8 mgd, gain in flow of the river was 6.6 mgd, and discharge from industrial wells was 4.5 mgd.—*from* Authors' abstract

9122 **Winslow, John H.** Raised submarine canyons—An exploratory hypothesis: Assoc. Am. Geographers Annals, v. 56, no. 4, p. 634-672, illus., 1966.

Submarine canyons are now widely believed to have been eroded by submarine processes, possibly turbidity currents. Although they may resemble, in a general way, the typical subaerially eroded land valleys, they also possess distinct characteristics of their own. Regions that have emerged from beneath the ocean since, or possibly prior to, the mid-Tertiary might still have relict submarine canyons on their surfaces. Enigmatic coastal indentations, such as certain fjords, estuaries, rias, and lagoons, together with some dry and underfit stream valleys, may be of this origin. Many bear a resemblance to submarine canyons and some appear to be linked with present canyons on the continental shelves. A number of problems that have been part of conventional interpretation of their origins are resolved by this hypothesis; a few new problems, it must be admitted, are created.—Author's abstract

Wisotsky, Serge. *See* Krause, Dale C. 9059

8972 **Wood, W. H.** Facies changes in the Cambrian Muav Limestone, Arizona: Geol. Soc. America Bull., v. 77, no. 11, p. 1235-1245, illus., tables, 1966.

In the stratigraphic profile of the Muav Limestone from Diamond Creek to Yampai Cliffs, Arizona, every member shows evidence of shoreward facies change in a southerly direction. Facies relationships within Tongue Bright Angel (2) suggest that a southeasterly trending embayment of the Muav sea extended through the Yampai Cliffs area during part of Middle Cambrian time; the axis of this embayment lies along a line connecting Columbine Falls, Bridge Canyon, and Yampai. Within the Peach Springs Member, facies relationships support this interpretation and indicate that the east side of the embayment was controlled by a north-south hinge line located approximately along the Mohave-Yavapai County boundary.—Author's abstract

9193 **Woodward, Lee A.** Late Precambrian tectonic setting of the eastern Great Basin [abs.], *in* Guidebook of Taos–Raton–Spanish Peaks country, New Mexico and Colorado—New Mexico Geol. Soc., 17th Field Conf., 1966: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 122, 1966.

9245 **Wright, Phillip Michael.** Geothermal gradient and regional heat flow in Utah [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 4, p. 1196B, 1966.

9226 **Wynne-Edwards, H. R.; Gregory, A. F.; Hay, P. W.; Giovanella, C. A.; Reinhardt, E. W.** Mont Laurier and Kempt Lake map-areas, Quebec—A preliminary report on the Grenville Project: Canada Geol. Survey Paper 66-32, 32 p., illus., table, geol. map, 1966.

The Precambrian plutonic and metamorphic complex of about 13,000 sq mi in central Grenville Province can be divided into five tectonic categories: a pretectonic basement complex which may correlate with the Archean rocks across the Grenville front near Val d'Or; an overlying, pretectonic metasedimentary Grenville Series; pretectonic, coarse-grained plutonic igneous rocks emplaced in the Grenville Series before the orogeny and subsequently deformed; syntectonic and late tectonic plugs; and post-tectonic diabase dikes. Stereographic projections are set out on the accompanying structural map; a simple structural pattern from which the tectonic history can be inferred is produced. Three distinct domains are present as a result of superposition of Grenville orogeny folds on a set of east-west trends in the northwest domain, and on north-south trends in the central and southeast domains. Economic geology is reviewed briefly.—E.S.L.

Yarbrough, H. F. *See* Davis, J. B. 9306

9148 **Yates, R. G.** Geology—Northeastern Washington, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 15-22, illus., 1966.

Northeastern Washington, commonly known as the Okanogan Highlands, includes Pend Oreille, Stevens, Ferry, eastern Okanogan, and northern Spokane Counties, and comprises less than 15 percent of the State's area, but produces over 90 percent of the State's metal production. The Columbia River divides the Highlands into two parts. The oldest rocks in the State with well-established ages are east of the river and are demonstrably older than Early Cambrian age. Paleozoic rocks of this section are all marine sediments. In the western Highlands rocks range from Mississippian to Cretaceous in age and are associated with numerous volcanic rocks.—W.L.G.

Yochelson, Ellis L. *See* Boucot, Arthur J. 9175

9145 **Young, E. J.; Lovering, T. G.** Jasperoids of the Lake Valley mining district, New Mexico: U.S. Geol. Survey Bull. 1222-D, p. D1-D27, illus., tables, 1966.

A study in the Lake Valley mining district, N. Mex., of selected bodies of jasperoid involved application of criteria for distinguishing between jasperoid favorable or not for association with silver and base metal mineralization; results revealed some favorable bodies in an unprospected area more than a half mile from known ore. Three jasperoid bodies and a bedded chert were studied, mapped, and sampled in detail; samples were also collected from within the mined area. Comparisons were made between host rocks and jasperoid along two traverses, and changes in the contact zone were investigated by petrographic and spectrographic analyses; samples showed more iron, titanium, aluminum, and barium in the jasperoid than in the host dolomite, and more calcium and magnesium on the jasperoid side and more silica on the dolomite side, indicating major elements are diffused in both directions from the contact.—*from* Authors' abstract

9074 **Young, Edward J.; Sheridan, Douglas M.; Munson, Elaine L.** Manganese and strontium-bearing fluorapatite from the Peerless pegmatite, South Dakota: Am. Mineralogist, v. 51, nos. 9-10, p. 1516-1522, illus., tables, 1966.

An apatite rich in manganese and strontium has an excess positive charge of 0.26 suggesting that 0.13 atoms of oxygen per unit cell be added to the formula. Analyses, X-ray diffraction, and optical data are given.—M.L.L.

9076 **Young, Edward J.; Munson, Elaine L.** Fluor-chlor-oxy-apatite and sphene from Crystal Lode pegmatite near Eagle, Colorado: Am. Mineralogist, v. 51, nos. 9-10, p. 1476-1493, illus., tables, 1966.

Crystals of apatite and sphene an inch long occur in vugs. Chemical analyses of the apatite show that positive or cationic charges are 0.65 greater than negative anionic charges. Charges may be neutralized by adding 0.32 oxygen to the formula. Normally, apatite contains 26(O, F, Cl, OH); the proposed formula contains 25.68. The added oxygen brings a closer agreement between measured and calculated densities. Optics, X-ray diffraction, magnetic susceptibility, and differential thermal analysis data are given.—M.L.L.

9471 **Young, G. M.; Church, W. R.** The Huronian System in the Sudbury district and adjoining areas of Ontario—A review [with French summ.]: Geol. Assoc. Canada Proc., v. 17, p. 65-82, illus., 1966.

Detailed mapping in the region of the north shore of Lake Huron has revealed a sequence of formations comparable to that of the "original" Huronian of the Bruce Mines-Blind River area. In the McGregor Bay area rocks similar to the youngest of the Cobalt Group are conformably overlain by ferruginous sedimentary rocks correlative with the Animikie of the Lake Superior region. The sequence between La Cloche Mountains and Espanola, considered by Collins to be Huronian, is confirmed. Underlying rocks north of Espanola, formerly assigned to the pre-Huronian Sudbury series, have been correlated by Ginn with lower part of the Huronian in the Elliot Lake region. It is concluded that all the sedimentary rocks in the wedge-shaped area southwest of Sudbury are Huronian, thus supporting the original opinion of Murray and Logan.—G.D.C.

9001 **Young, Grant M.** Huronian stratigraphy of the McGregor Bay area, Ontario—Relevance to the paleogeography of the Lake Superior region—A reply to discussion by M. J. Frarey [1966]: Canadian Jour. Earth Sci., v. 3, no. 7, p. 999-1002, 1966.

The correlation proposed in the original paper (ibid., v. 3, no. 2, p. 203, 1966) is supported by stratigraphic similarities, similarities in style and trend of fold patterns in the two areas, similar igneous and metamorphic histories, and the available age determinations.—M.S.T.

9194 **Young, Robert G.** Stratigraphy of coal-bearing rocks of Book Cliffs, Utah Colorado, *in* Central Utah coals—A guidebook prepared for the Geological Society of America and associated societies: Utah Geol. and Mineralog. Survey Bull. 80, p. 7-21, illus., 1966.

Book Cliffs are composed of the Mancos Shale, largely Late Cretaceous in age, capped by the more resistant sandstones and shales of the Late Cretaceous-early Tertiary Mesaverde and basal Wasatch Formations. A parallel but higher escarpment to the north is formed in the Wasatch and Green River Formations. The pronounced sinuosity of the escarpment reflects large Tertiary uplifts and smaller anticlines. Mineable coals are present only in Upper Cretaceous units, details of which are discussed, cyclic sedimentary environments described, and facies illustrated, particularly for the Star Point, Blackhawk, and Price River Formations. Coal-bearing rocks associated with barrier beach deposits are of lagoonal, paludal, and possibly estuarine origin, derived from western source areas and transported across floodplains by meandering streams.—G.D.C.

9337 **Yourt, G. R.** Radiation hazards and control at Ontario uranium mines: Inst. Mining and Metallurgy Trans., Sec. A, v. 75, Bull. 719, p. A182-A188, illus., tables, 1966.

Two potential internal radiation hazards are described, both involving radium in uranium ore. Of major importance is airborne radon and its disintegration products in underground operations; dissolved radium in mine and mill effluents is a minor

problem. A description of experience and control measures in Ontario is given, specific survey data from mines operated by Rio Algom Mines, Ltd., being included.—Author's abstract

8990 **Zimmer, P. W.** A unique intergrowth of calcite and pyrite [abs.]: Am. Mineralogist, v. 51, nos. 9–10, p. 1563, 1966.

9275 **Zimmerman, Tom; Moen, W. S.** Sand and gravel, *in* Mineral and water resources of Washington: U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print, p. 251–257, illus., 1966.

Deposits of sand and gravel occur in every county of the State but vary both in quantity and quality, and are adequate for most present and near-future needs. These deposits are shown on a figure. The sand and gravel deposits are separated into six districts and each district is described and discussed.—W.L.G.

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